THE WHEELWRIGHT'S TRADE

No. 10 IN A SERIES OF SOURCEBOOKS

Containing illustrations and extracts from early trade journals and manufacturers' catalogues.

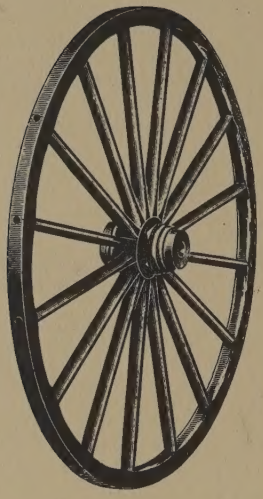
Compiled and Introduced
by

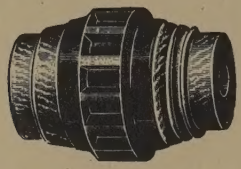
John Thompson

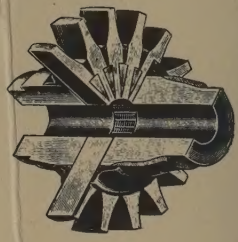
12.95

WARNER WHEELS ENGLISH MADE

BEST QUALITY XXX







WARRANTED
ALL MADE FROM
SELECTED
AND
SEASONED TIMBER

BEST QUALITY
AND
WORKMANSHIP

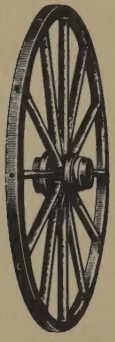
PRICES PER PAIR

No. of Wheel	Height of Wheels in the Wood	Size of Spokes	12 Spokes Ordinary Felloes	14 Spokes Ordinary Felloes	16 Spokes Ordinary Felloes	Bent Rims Extra	Tyring including Nave Hoops
4001	Up to 3 ft. 5 in.	⅞ and 1 in.	£1 12 0	£1 14 6	£1 17 0	£0 5 3	£0 18 6
4002	,, ,,	1⅛ ,, 1¼ ,,	1 14 6	1 17 0	2 0 0	0 5 3	0 18 6
4003	,, ,,	1⅜ ,, 1½ ,,	1 17 0	2 2 6	2 8 0	0 8 0	1 1 0
4004	,, ,,	1⅝ in.	2 0 0	2 5 0	2 10 6	0 8 0	1 4 0
4005	,, ,,	1¾ ,,	2 2 6	2 8 0	2 13 0	0 8 0	1 6 6
4006	,, ,,	1⅞ ,,	2 5 0	2 10 6	2 16 0	0 8 0	1 6 6
4007	,, ,,	2 ,,	2 10 0	2 15 0	3 0 0	0 10 6	1 9 0
4008	,, ,,	2⅛ ,,	2 16 0	3 1 0	3 6 6	...	1 9 0
4009	,, ,,	2¼ ,,	3 4 0	3 9 0	3 14 6	...	1 12 0
4010	,, ,,	2½ ,,	3 14 6	3 19 6	4 5 0	...	1 14 6
4011	3 ft. 6 in. to 4 ft. 3 in.	⅞ and 1 in.	...	1 17 0	2 0 0	0 5 3	1 1 0
4012	,, ,,	1⅛ ,, 1¼ ,,	...	2 0 0	2 5 0	0 5 3	1 4 0
4013	,, ,,	1⅜ ,, 1½ ,,	...	2 5 0	2 10 6	0 8 0	1 4 0
4014	,, ,,	1⅝ in.	...	2 8 0	2 13 0	0 8 0	1 6 6
4015	,, ,,	1¾ ,,	...	2 10 6	2 16 0	0 8 0	1 9 0
4016	,, ,,	1⅞ ,,	...	2 13 0	2 18 6	0 8 0	1 9 0
4017	,, ,,	2 ,,	...	3 0 0	3 6 0	0 10 6	1 12 0
4018	,, ,,	2⅛ ,,	...	3 6 6	3 11 6	...	1 12 0
4019	,, ,,	2¼ ,,	...	3 14 6	3 19 6	...	1 14 6
4020	,, ,,	2½ ,,	...	4 5 0	4 10 6	...	1 17 0
4021	4 ft. 4 in. to 4 ft. 10 in.	1⅞ to 1½ in.	...	2 10 6	2 16 0	0 8 0	1 6 6
4022	,, ,,	1⅝ in.	...	2 13 0	2 18 6	0 8 0	1 9 0
4023	,, ,,	1¾ ,,	...	2 15 6	3 1 0	0 8 0	1 12 0
4024	,, ,,	1⅞ ,,	...	2 18 6	3 4 0	0 8 0	1 12 0
4025	,, ,,	2 ,,	...	3 6 0	3 11 0	0 10 6	1 14 6
4026	,, ,,	2⅛ ,,	...	3 11 6	3 17 0	...	1 14 6
4027	,, ,,	2¼ ,,	...	3 19 6	4 5 0	...	1 17 0
4028	,, ,,	2½ ,,	...	4 10 6	4 15 6	...	2 0 0

Screwing Rims up to 1¾ in. 2/6, above 1¾ in. 3/- per pair extra Double Rivets 2/- per pair extra
Boring out for Bushes 1/- each Bushing and Wedging 4/- per pair extra
For Prices of Brass, White Metal and Special Nave Hoops see pages 30 and 31

When ordering please state Height in the Wood, Size and Number of Spokes, Length of Naves, Width of Sole and whether Bent Rims or Felloes are required
If Tyred, state Width and Thickness of Tyres Also state Width of Nave Hoop

BEST QUALITY LIGHT CART WHEELS



No. of Wheel	Height of Wheel in the Wood	Size of Spokes	No. of Spokes	Price per pair in the Wood	Tyring Extra per pair	Width and Thickness of Tyres
4029	Up to 2 ft. 8 in.	1⅜ 1½ or 1⅝ in.	10	£1 3 6	£0 13 0	1⅜ × ½ in.
4030	,, ,,	,,	12	1 4 6	0 13 0	1½ × ½ ,,
4031	2 ft. 10 in. to 3 ft. 2 in.	1½ and 1⅝ in.	12	1 5 6	0 13 0	1½ × ½ ,,
4032	,, ,,	1¾ in.	12	1 6 6	0 14 0	1½ × ⅝ ,,
4033	3 ft. 4 in. to 3 ft. 6 in.	1½ and 1⅝ in.	12	1 7 6	0 14 0	1½ × ⅝ ,,
4034	,, ,,	1¾ in.	12	1 8 6	0 15 0	1⅝ × ⅝ ,,
4035	,, ,,	1⅞ ,,	12	1 9 6	0 16 0	1¾ × ⅝ ,,
4036	3 ft. 8 in.	1⅝ ,,	12 or 14	1 9 6	0 15 0	1½ × ⅝ ,,
4037	,,	1¾ ,,	12 or 14	1 11 0	0 16 0	1⅝ × ⅝ ,,
4038	,,	1⅞ ,,	12 or 14	1 12 0	0 17 0	1¾ × ⅝ ,,

Prices of Tyring include Nailing and Dressing off Riveting extra
Nave Hoops 2/- to 3/- per pair extra
Naves turned to any shape required Special Prices for 12 pairs and upwards together

From Jonas Woodhead of Leeds Catalogue, 1906.

THE WHEELWRIGHT'S TRADE

The assembly shop of Henry Eaton, a large Manchester firm, taken around 1900. The trolleys on the right with hoops for tilts (canvas covers) are for the Great Central Railway Co.

THE WHEELWRIGHT'S TRADE

A SOURCE BOOK

by

John Thompson

SOURCE BOOKS IN THIS SERIES:–

1 Horse Drawn Trade Vehicles
2 Horse Drawn Heavy Goods Vehicles
3 Horse Drawn Farm Implements – Part I. Ploughs
4 – Part II. Preparing the Soil
5 – Part III. Sowing and Haymaking
6 – Part IV. Harvesting
7 Horse Drawn Carriages
8 Horse Drawn Farm Vehicles
9 Horse Drawn Carriage Construction
10 The Wheelwright's Trade

IN COURSE OF PREPARATION –

11 Horse Drawn Omnibuses

Acknowledgements:–

I am grateful to Jocelyn Bailey, Bill McCook, Gordon Offord and D.A. Waddingham for the loan of original manufacturers catalogues, trade journals and photographs. The photographs on pages 8, 20, 21, 23, 24 and 25, were supplied by the Museum of English Rural Life, University of Reading.

First Published 1983

by

John Thompson, 1 Fieldway, Fleet, Hampshire, U.K.

This selection with additional material John Thompson 1983

ISBN 0906922 09 7

Printed and Produced by Charterlith, 30 Reading Road South, Fleet, Hampshire.

Illustrations above and overleaf are from "The Microsm", by William Pyne, 1804. Note the double row of strakes on the rim of the wheel, and in the sketch overleaf the wooden axle arm, in general use at that date.

CONTENTS

An Introduction to the material 6
Timber for the Wheelwright 8
Seasoning of Timber 12
How Carriages were built in Early Days 15
The Village Wheelwright 21
Wheel-making and Repairing for Coachbuilders 26
A Pit-frame for Wheel Making 29
How to Box a Wheel 31
Wheel Construction 32
The Wheelwrights' Suppliers 40
The Blacksmith's Shop 45
Modern Tyring Plant 50
A Wheel Manufacturer – "Westyres" 53
A Vehicle Builder – "Henry Eaton of Manchester" 59
Crosskills of Beverley 64
Foreign Wheelmaking Methods 66
Cooke's of Lincoln 68

AN INTRODUCTION TO THE MATERIAL

Many readers will have a mental image of the Wheelwright as a rural craftsman serving a local community and working in the ways which had been handed down for generations.

The classic book on the subject is 'The Wheelwright's Shop', by George Sturt (Cambridge University Press) and, as the extract on Page 20 shows the book is a remarkable evocation of the traditional country workshop. I number myself as one of the many people whose interest in the subject began with reading this unique book.

George Sturt described the skill and feeling which went into the construction of a farm waggon and lamented the passing of the last generation which worked in that tradition. Economic forces made the change inevitable and in fact by 1884 when George Sturt took over his father's workshop it was already an anachronism compared with the mechanised factories in the cities. I would estimate that by 1900 at least ninety five percent of horse-drawn vehicles made in Britain were factory built, either in large works where separate shops dealt with different phases of manufacture or in smaller establishments where most components were 'bought out', so that the builder was only dealing with the final assembly.

George Sturt wrote "The complete Wheelwright, acquiring skill of eyes and hands to make a wheel, was good enough workman then for the job of building a waggon throughout and painting it too; and all this was expected of him." However he was writing of a small firm employing a handful of men, and even in those circumstances I doubt that George Sturt's sentiments were strictly true to life. Certainly in London where all craft work had been dominated by trade guilds for centuries there was a clear demarcation between the various skilled workers.

In this book I have included a few original photographs of the traditional rural craftsmen but the bulk of the material relates to the larger works. By the 1890's the railway system in Britain was at its zenith, but far from harming the Wheelwright's trade this provided a greater volume of work. Both passengers and goods carried by the railways had to be transported from the stations by vast fleets of horse drawn cabs, vans and drays. Most of these vehicles were built in factories, many of which followed the lead taken by the United States in the use of machinery.

Very little published material about the merchanised side of the Wheelwright's trade is accessible to the general public although a good deal must be hidden away in copies of journals such as "The Coachbuilder's and Wheelwright's Art Journal" as well as in more general magazines such as "The Engineer". Therefore it was fortunate that some manufacturers' catalogues, which give a good idea of the appearance and equipment of a wheelwright's works, came my way.

In this book I have tried to present a picture of the Wheelwright's trade at its zenith, but I would not like to give the impression that the craft is dead today. Techniques have progressed and modern materials are in use now.

Traditional wheels are still built but for competition driving the strength of hollow steel sections is more practical and some builders make use of laminated wood and epoxy resins.

The workshop of A.E. Bailey, at Kingsnorth, Kent, in 1925. Mr Bailey is on the right. His son Bert still runs the business in the same workshop, and Bert's wife Jocelyn has written several books and articles on the wheelwright's craft.

Before the advent of the steam sawmill most timber was converted in the wheelwright's yard, by itinerant sawyers. The top sawyer guided the cut, and the bottom sawyer worked in the pit below.

TIMBER FOR THE WHEELWRIGHT

This very practical account is an extract from the Royal Army Transport Corps Manual, which also gives useful information on repair work and design of vehicles.

Wood Structure. – A log of timber is made up of the following parts:–

The "pith" occupying the centre of the stem. It becomes dried up and compressed as the wood hardens, and often finally disappears.

The "wood" which surrounds the pith. It is arranged in annular concentric rings, which usually remain active during several years, but in older stems the central layers become hard, dense, and comparatively inactive, and usually deeper coloured, forming the "heartwood"; the outer, younger, and paler coloured layers forming the "sapwood."

The "medullary rays," which form vertical plates, originating in the pith and radiating from it, traverse the wood, and terminate in the bark. They keep up a communication between the living portion of the centre of the stem and its outer surfaces. As the "heartwood" is formed, the inner portions of the medullary rays cease to be active, but they may usually be seen in old wood, being known as the "silver grain".

ANY SIZE
MADE TO ORDER
IN A FEW HOURS.

IRONED SHAFTS
AND
FORE-CARRIAGES.

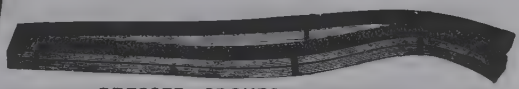
THOMAS W. HOPTON,

MANUFACTURER OF

WARNER OR PLAIN WHEELS AND BENT TIMBER BY STEAM MACHINERY,

COLLINGWOOD WORKS,

BROADWALL, BLACKFRIARS, LONDON, S.E.



LANCEWOOD SHAFTS,
ASH SHAFTS,
HICKORY SHAFTS,
BROUGHAM & PHAETON SHAFTS,
HOOPS FOR VANS,
CARRIAGE HEADS,
COACH POLES,
VAN POLES,
MOULDINGS,
AXLE BEDS,
and Bent Timber of Every Description.

DRESSED SPOKES,
"Acorn" Brand.
WARNER HUBS,
BENT RIMS,
TURNED NAVES,
FELLOES,
BIRCH,
PINE,
WHITEWOOD,
KAURI PINE,
Etc., Etc.

BUILT UP WOOD,

For roofs of Broughams, Cabs, Vans, Carts, etc., also for Panels of Vans, Carts and other Vehicles.

Perforated or plain built-up Seating for Tramway Cars, Omnibuses, &c.

This wood is very largely used by the principal Carriage Builders of Europe and America and has no equal for the purposes named above.

The Boards are cut round the log of timber with the grain, and built up of three thicknesses, each leaf being one eighth or one sixteenth of an inch thick, the centre leaf being crossed the opposite way of the grain, so that shrinkage or splitting is an impossibility. The roofs for Broughams or Cabs are $\frac{3}{8}$ths of an inch thick and compassed about $2\frac{1}{2}$ to 3 inches to suit the curve of the roof.

An advertisement from a 1910 issue of the "Coachbuilders and Wheelwright's Art Journal". Note the description of "Built up Wood", which we now call plywood.

Defects. – Timber should be free from the following defects:–

"Heartshakes", or longitudinal cracks passing through the centre of the timber. "Starshakes," or cracks radiating outwards. "Cupshakes," when the cracks take a circumferential instead of a radial direction, thus separating two adjacent annular rings; if of any size they are a serious disadvantage. "Upsets," where the fibres have been curled and crumpled by compression. "Rind galls," or wounds received in one of the older layers when young, and over which the more recent layers have not grown. "Dead knots," or knots which are separated from the adjacent timber. "Hollow" or spongy places proceeding from decay.

Timber, particularly elm and ash, is liable to become "doated" from lying in wet. It is made evident by spots of yellow colour in the wood.

In a good specimen of timber the woody fibre will adhere firmly together and when freshly cut will show no woolliness, nor clog the teeth of the saw cutting it. The freshly cut surface will be firm and shining, a dull surface is a sign of bad timber. The rule about clogging the saw applies especially to oak and ash. Deal clogs when sawn lengthways, on account of its softness.

British woods. – The chief British woods used are oak, ash, elm and beech.

Oak is the strongest, toughest and most durable, its strength being due to its great rigidity or stiffness. It is also fairly elastic and of moderate weight.

Oak contains an acid which corrodes iron on contact with it.

Oak is not suited to foreign climates, as it is liable to shake when exposed to extreme dryness.

Oak is used for spokes, skids, ground rollers, frames of waggons and carts.

Ash is a tough wood, remarkable for its elasticity. It does not stand exposure to the weather well, and in store is liable to suffer from worm.

Ash is used for shafts, poles, felloes, frameworks of some carts and wagons, being lighter than oak and strong enough for the purpose.

Elm is a very cross-grained wood, and therefore, little liable to splinter. It is also very durable if kept constantly under water. It is particularly valuable for work which has to take many nails, or has many holes cut in it, but elm seasoned artifically will split as easily as deal.

Elm is used for the naves of wheels, axletree beds, blocks, ends of deal boxes, scotches, footboards of limbers, and rollers.

Beech is a hard, strong, white wood, but will not stand exposure to weather. It works up very clean and smooth.

Beech is used for internal fittings for ammunition boxes, saddle trees, tool handles, etc.

Timber in the Crofords premises in Ashford, Kent, photographed by Jocelyn Bailey in 1977. The elm nave lugs and the fellie blanks are stored in an open sided shed to season.

SEASONING OF THE TIMBER

Extract from an essay by J.S. Foggett, written for the Worshipful Company of Coach Builders in 1881 (See page 27 for further details of source).

SEASONING

Hubs. For these the butts of small trees should be selected and cross-cut at a saw bench into lengths of about 9ft. These should be stacked in the open air, and allowed to remain in this position for a period of nine months, which, with the time elapsing between felling and stacking, gives twelve months preparatory seasoning. The wood is then cut into lengths of 10 in or 12 in, and the bark removed. This can be done by a band saw, the table of which should be fitted with a centering guide. By removing the bark drying is greatly facilitated, and for internal drying a hole should be bored completely through the center at a lathe having a V clamp on the rest for holding the wood in position, care being taken to remove the pith, as, if this is left on one side of the centre, the stock is liable to split in seasoning. It is also advisable to cut off part of the sapwood, though when the nave is turned down to its final diameter, little or no sapwood remains. The ends should have a coat of paint, or be covered with an air-resisting substance, such as resin; or a mixture of boiled oil and tallow may be substituted. This latter plan is common in the United States, where seasoning wheel timber is looked upon in the light of a science.

The greatest care should be exercised in storing hubs for drying in a perfectly dry situation, neither too light nor too dark. They should be placed on ends in rows separated by strips of timber, and turned over once in every three months. The time required for seasoning a nave thoroughly, varies from one to two years, according to the conditions to which it is subject.

Spokes. The three is cross-cut into lengths varying from about 1ft 8in to 2ft 4in, and this is better done a short time after felling. Cleft or riven spokes are undeniably better than those that are sawn, as the grain is preserved throughout the whole length. In cleaving, the log is split longitudinally by wedges, and marked off in a series of wedge-shape divisions, these being cleft out with a large knife. Though some of the sapwood is generally chopped off, some is often left; but in good timber it is almost as tough as the heart, especially if the bark has not been removed whilst the tree was standing. The spokes are now to be piled or stacked in the open air, protected from sun and rain. After drying nine months in this way they should be transferred to a dry shed, and there stored until thoroughly seasoned and ready for working up. The time occupied in seasoning a spoke is from eighteen months to two years.

Felloes. Ash, if felled at the time named, is exceedingly durable, and, as in the case of spoke wood, is benefitted by being left in the round for a short time only. It may be mentioned that decay in this wood is readily detected by the centre turning dark coloured. The tree is planked and cut by a saw to patterns or templets of the required curve, the grain in all cases running with the length. In some places two felloes are cut at one operation. The sizes in the rough vary from 14in long ¼ 1 ⅞ in to 2ft 4in x 3in x 3in. For seasoning, felloes are treated in the same manner as spokes.

The importance of thoroughly seasoned wheelwood cannot well be exaggerated, as if worked up in an unseasoned state the tenons of spokes become too small for the mortices, the stock shrinks, and the tire works loose and requires re-setting. For rapid seasoning, heated rooms are frequently used for storing the timber; but besides splitting, the wood is weakened by this process. Frequently in America, and sometimes in England, wet timber is boiled or steamed before being seasoned, naturally or artificially, and it is believed that by this means the drying may be accelerated, although most practical men are of opinion that the timber is less durable when so treated. There are also several patented methods of seasoning timber by the action of steam, carbonic acid gas, and various chemicals; but of their merits the writer can say little.

No. 9 – Dry naves.

ESSENTIALS

Essential elements of High-grade Wheels are :—

THOROUGHLY-SEASONED TIMBER
AND FIRST-CLASS WORKMANSHIP

First-class workmanship is thrown away on unseasoned Timber. Hitherto the only sure way of obtaining thoroughly dry material for all emergencies has been for the wheelwright to carry large stocks and season his own.

This involved large outlay of capital, expense for storing, expense for double and treble handling and loss through faults developing in seasoning.

We are now offering the finest line of Machine-dressed Spokes ever made in Australia. They are of high-grade material, of neat and uniform pattern, footed ready to drive, and thoroughly dry. Absolutely the best line of spokes ever offered.

SPECIFY "WESTYRE" WHEELS

Taken from the catalogue of "Westyre" of Sydney, Australia.

No. 7—SOME OF OUR DRY FELLOES.

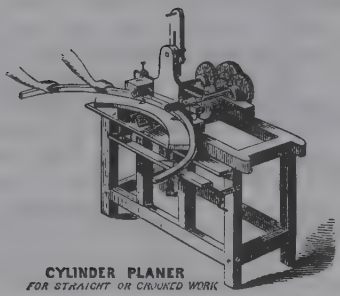
No. 8—DRY SPOKES.

"Westyres" of Sydney, Australia, supplied wheels with naves of iron bark and fellies of blue gum.

HOW CARRIAGES WERE BUILT IN EARLY DAYS

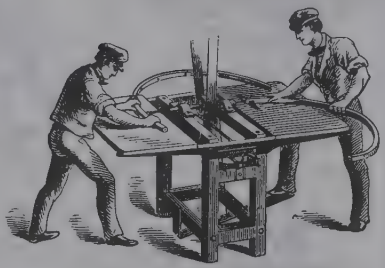
By Charles Eckhart, Auburn, Ind.

Charles Eckhart read this speech at the 'Carriage Builders of North America' convention in 1910, and this text is taken from the report printed in the October 1910 issue of 'The Hub'. Thus Eckhart is describing conditions in the trade around 1860 and even at that time the larger workshops in the cities had begun to use labour saving equipment.



CYLINDER PLANER
FOR STRAIGHT OR CRANKED WORK

FOR RIVETING AND SCREWING FELLOES



BORING AND DOWELING MACHINE

My subject is this morning, "How Carriages Were Built in the Early Days." I will start out by saying that on the 12th day of next October it will be fifty-three years since I commenced the trade. I am a practical mechanic in three branches, woodwork, painting and trimming. I know all three and can do one just as well as the other, although I have not done anything at it for about twenty years.

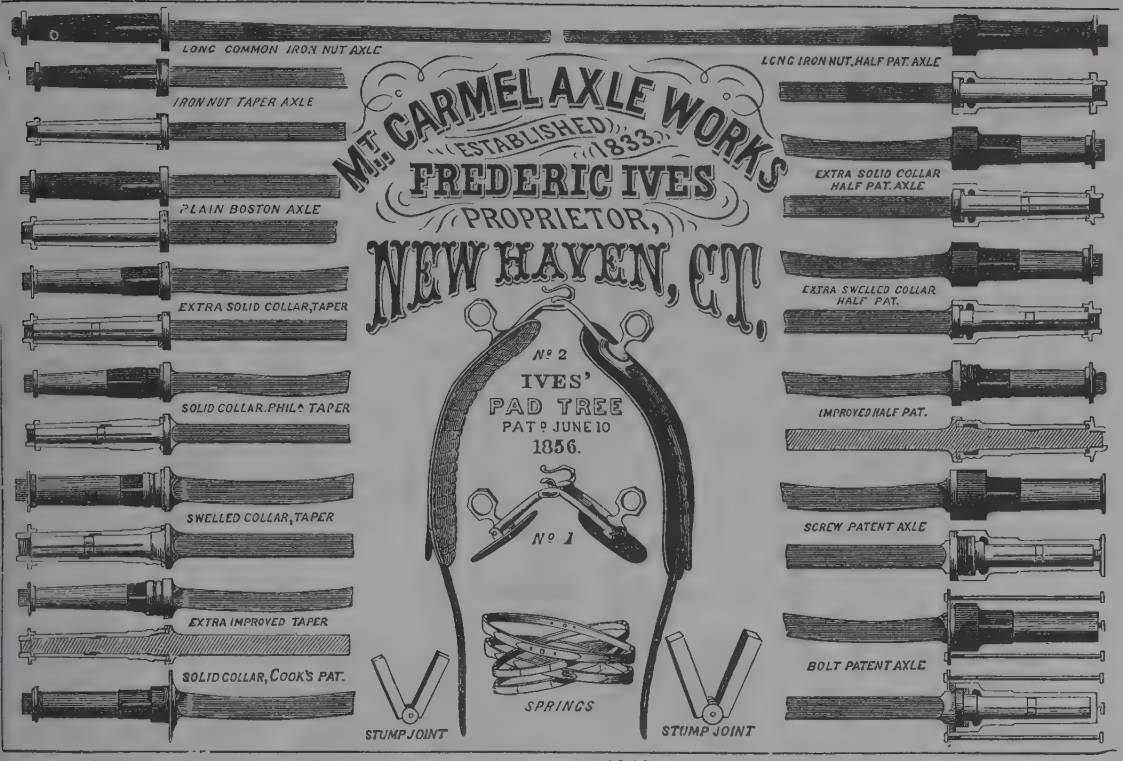
I will start in with the woodwork, because that is what I learned first. I will mention some of the conditions that existed at the time and compare them with the conditions which exist to-day. I learned my trade in the country. Of course, it was different in the city; they do a different class of work in the city, and get more money for it. But I learned my trade in the country, and we had to work not ten hours a day, or eight hours a day, but we commenced in the fall of the year at the October election, and worked every night in the winter excepting Sunday, till nine o'clock. We used to have to work for our board and washing for two years and a half, and that is all we got. I remember very distinctly my boss was very liberal-hearted, and the first nine months that I was with him he gave me a dollar and a quarter !

Now, I will commence with the wheels. We used to go out in the timber and cut down a hickory tree or an oak tree, cut it up in blocks, split the blocks and take them to the shop and put them on the outside for nine months or a year to season them. Then we would take them in, cut them to length, hew them and plane them up, and cut the tenons on them by hand, round them up by hand;

and at that day it was a very fast workman who could make a set of spokes in two days' time. We had at that time mortised hubs; we also had finished spokes that were made, I believe, in Philadelphia at that time, and other places; but most of the people in the country made their own spokes. We even had to turn our own hubs with a hand lathe and mortise them. We had to bend the rims at that time and we used to saw the rims out with a gate saw. Many of the wheels we made one and a quarter inch tread, with a single back. Gear woods were gotten up, most of them, out of split stuff. All the spring bars, doubletrees, singletrees and such work we had to cut out of split stuff. Even axles, at that time we used to make axles two and one-half inch spindles and two and a quarter inch spindles in the carriage business; and if you wanted to make an axle and make it to shape, you would cut a piece of timber and just split it off the proper length, dress up the bottom of it, take the sap stuff off the bottom and hew it out to make an axle.

We used to use the old lynch-pins at that time; lay the iron into the spindle and add the lynch-pin and it is quite a job to do that; we didn't have any skeins at that time.

Below: – An early advertisement for wheelmaking machinery which appeared in a catalogue published by G.D. Cook of New Haven, Connecticut in 1860.



Another advertisement for the G.D. Cook catalogue of 1860.

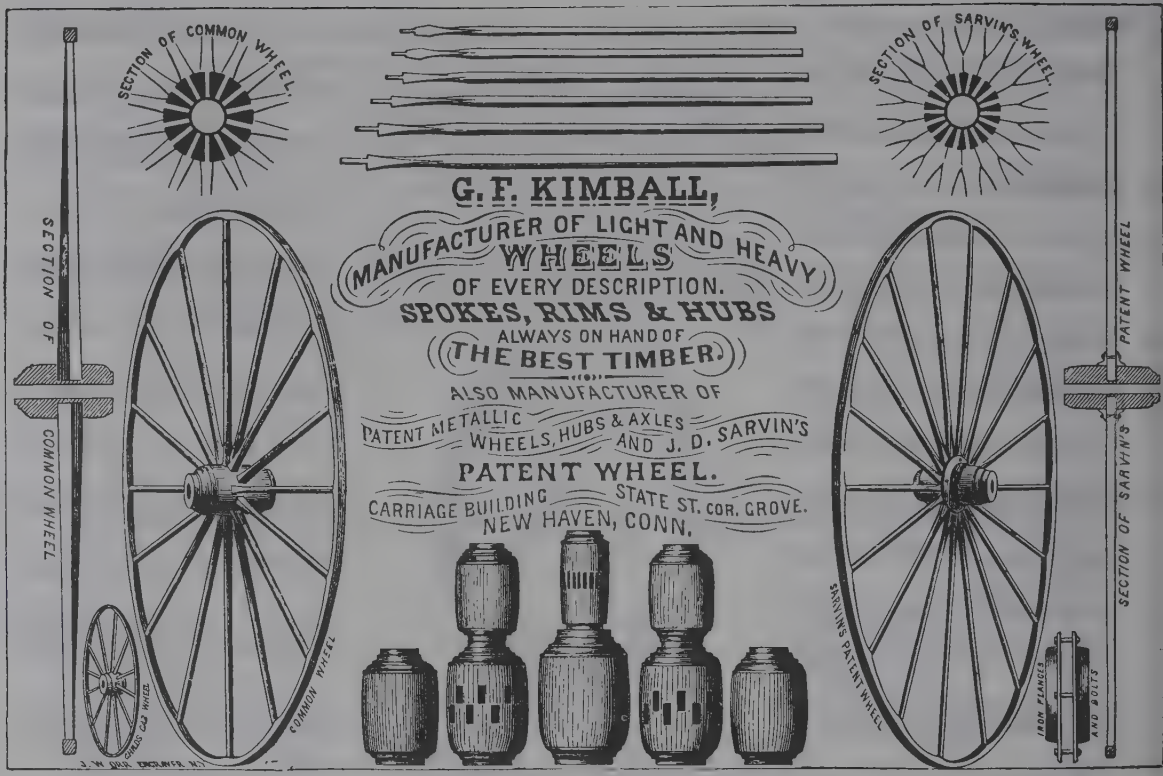
Then we come to the bodies. All the stuff now is made dressed up, you know, ready for use; but we had boards then; and we had to bend the boards sometimes three-quarters of an inch thick or five-eighths inch thick, and say 28 to 30 inches wide, and we had to dress these down with a jack plane. Some of the carriages that were made at that time had solid mouldings on them, even on the backs of them, and also on the sides; and there were very few tools used at that time, just a jack-knife and probably two or three chisels, and we had to work them out solid.

Most of those jobs done in the country were standing jobs. A great many of them had a door on the side. There were four to six posts or eight posts, and we had to make the doors. We used ash timber for the posts.

Now, we will come to the iron work. I am not an iron worker, but I think I know what an iron job is when I see it. In iron work fifty years ago they used to have but very few sizes of iron and we had to forge it and make it to size. They forged their own bolts, their own clips, and they made their own springs, and nearly everything that was gotten up at that time in the way of iron had to be forged out.

You would be surprised to know that we used to have to pay twenty-five dollars forty years ago to get a buggy ironed. It was quite a job and it took a man sometimes two weeks to iron it. They had to get out everything by hand, and they worked with their old-fashioned machinery. For instance they did not have any power drills, not even a hand drill; but they had to take a stock of timber, put their drill in and work it around with a crank. They had to make their own bits. I tell you, it was a crude thing. To-day we have the power drill. We can drill more holes in a wheel to-day for a given bolt in an hour than you could do in two weeks then.

Now, we come to the painting. It was certainly very amusing to see how we used to paint a buggy at that time. We had what is called a marble slab about twenty inches wide and probably three inches thick, and a muller, a round stone about four inches in diameter, and about eight inches high.



Another advertisement for the G.D. Cook catalogue of 1860.

The boss would tell us: "Now, I want you to grind some paint for a gear." We would take some paint that was all dry and hard and lumpy, put it on to the stone and mix with the oil, turpentine and japan or litharge for a dryer. We took what we considered enough to paint the gear. Then you would have to grind that about two hours to get it fine enough. We used to try it with our fingers in order to see if it was fine enough. Of course, the apprentices would say it was fine enough, whether it was or not. It was all guesswork. You did not know whether the paint was going to dry in twenty-four hours or six days; you could not tell anything about it – just guesswork. Today you can buy a pound of paint for twenty-five cents, paint a buggy, and it will dry in two hours or an hour, and you can put a coat of varnish on it afterwards.

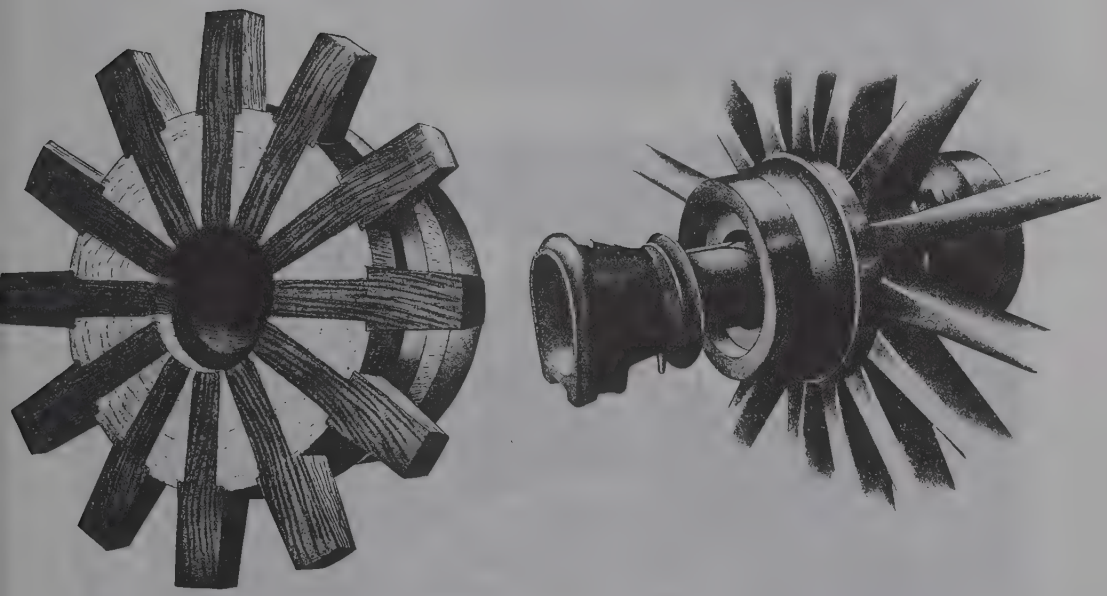
Now, that is the way we had to paint in those days. We did not have a very good place to paint it, and sometimes it would take two months to paint a buggy. It is just wonderful, the advancement that has been made to-day. In those days we did not have the interchangeable axles like they have to-day. We had to paint the jobs with the wheels on, and the rough stuff we had to mix while everything else was drying; we would mix up the oil, turpentine and japan. That is the way we used to paint our buggies.

Now we come to the trimmings. You know we didn't have any sewing machines in those days; everything was done by hand, all the stitching on the curtains, and the knob patches. It makes me laugh to-day when I think how we used to cut the knob patches out. We had a one and three-quarters inch stamp and stamped the leather out of calfskin, then we would take an awl to punch the holes in with, one-eighth of an inch apart all the way around, and then with a needle it would take a man a whole day to sew the knob patches for the job. The curtains all had to be stitched by hand, even the cushions; and everything of that character had to be made by hand.

We used to make the tops then out of oilcloth. I was talking to a friend over at the hotel this morning, and I told him my impression was that the oil cloth at that time did not crack in cold weather; that I was not quite sure about that, but I believed it did not crack.

At that time they were just beginning to make rubber goods to trim buggies, about forty-eight or fifty years ago. They were cheap affairs. We used to sell a job then – at that time, fifty years ago – for about $75 to $100. I will tell you it was a crude job, too. But they did last. Some of them lasted such a long while that we wished we had not made them so good.

When I think about the conditions existing today, as compared with the conditions existing at that time, the difference is very great. To-day we do not have a man learn a trade. We do not have to learn a trade to-day. A man comes in and asks for a job in a shop or factory. He says, "Well, I would like to have a job." We say, "What can you do?" "Well, I am a painter." You say, "Here is a job. I want you to paint that from the lead up." He says, "I don't know anything about putting lead on; the only thing I do is to stripe gears." You ask a man to trim a job through. You say, "Here is a job to trim. I want that trimmed in biscuit, or in any other style." He will just get heart disease; he just could not do it. I leave it to any gentleman in this convention whether you have five persons in your shops to-day that can do more than one branch of the business. Those are the conditions, and you all know it. I will make another statement, and if I am not correct you can call me down; that is, that there are not 10 per cent of the men to-day in the wholesale carriage business that can do any one branch of the business. It would be a great deal better if you could, for you would not have to depend on your foremen and superintendents. A man is fortunate today, that is in business, if he can tell what a job is himself, and does not have to depend upon anybody else to tell him.



Early American wheels ran on hickory axles, having wooden axle arms clad in iron 'skeins', as seen above. These illustrations are from a catalogue issued by the Owensboro Wagon Company, Kentucky. The resilience of the hickory timber is well suited to this type of construction and there was the practical advantage that a broken axle could be repaired 'on the trail'. Skein axle arms were never used in England.

The Wheelwright's shop at Kingsnorth in Kent is still active. Although most of the jobs consist of renovation and repair work this is not so very different from the pattern of years ago, as an examination of old ledgers will show. The lower photograph of Bert Bailey was taken by his wife Jocelyn in 1978, and the upper photo shows his father, taken in 1925.

The wheelwright's shop at Heydon, Norfolk, about 1900.

THE VILLAGE WHEELWRIGHT

To provide a background for this aspect of the craft I can do no better than quote two passages from the classic book on the subject, "The Wheelwright's Shop" by George Sturt, who lived in Farnham, Surrey. (Published by The Cambridge University Press).

The first extract stresses the local variations in design. It is certainly true that the traditional styles of English carts and waggons can be classified according to the locality, and to some extent the differences reflect the requirements of the users. However, I consider that most of the variations owe more to local custom, and to the conservatism of both farmers and wheelwrights than they owe to genuine practical considerations.

A wheelwright's shop at Stratton, near Bude in Cornwall, in about 1910. Nearest the road is a haycart, with rope rollers, whilst the other two vehicles are traps.

From "The Wheelwright's Shop":–

"The objects of the work too were provincial. There was no looking far afield for customers. Farmers rarely more than five miles away; millers, brewers, a local grocer or builder or timber-merchant or hop-grower – for such and no others did the ancient shop still cater, as it had done for nearly two centuries. And so we got curiously intimate with the peculiar needs of the neighbourhood. In farm-waggon or dung-cart, barley-roller, plough, water-barrel, or what not, the dimensions we chose, the curves we followed (and almost every piece of timber was curved) were imposed upon us by the nature of the soil in this or that farm, the gradient of this or that hill, the temper of this or that customer or his choice perhaps in horseflesh. The carters told us their needs. To satisfy the carter, we gave another half-inch of curve to the waggon-bottom, altered the hooks for harness on the shafts, hung the water-barrel an inch nearer to the horse or an inch farther away, according to requirements."

Photographs Opposite:–

The village blacksmith had a close working relationship with the wheelwright. The upper photograph, taken in 1899, is from our family album. The lad on the left is my grandfather and his father is on the far right. This family business was at Great Baddow in Essex, and as well as the shoeing and general blacksmith's work they undertook carrying and occasional horse-dealing.

The lower photograph is of a blacksmith's yard which dealt with a different type of trade. It appears that the firm has branched out into agricultural engineering. Note that in both instances the workshop and dwelling house are part of the same premises.

Another photograph of the Fawley wheelwright.

The second extract from "The Wheelwright's Shop" makes a valid point about the nature of the traditional craft. There is also a telling point at the start of the last paragraph where George Sturt refers to the "Mystery of square-tongued wheels". Reference to page 58 of this book will show that if he had been familiar with trade practices in other parts of the country there would have been no mystery.

From "The Wheelwright's Shop":–

"There was nothing for it but practice and experience of every difficulty. Reasoned science for us did not exist. "Theirs not to reason why." What we had to do was to live up to the local wisdom of our kind; to follow the customs, and work to the measurements, which had been tested and corrected long before our time in every village shop all across the country. A wheelwright's brain had to fit itself to this by dint of growing into it, just as his back had to fit into the supplenesses needed on the saw-pit, or his hands into the movements that would plane a felloe "true out o' wind." Science? Our two-foot rules took us no nearer to exactness than the sixteenth of an inch: we used to make or adjust special gauges for the nicer work; but very soon a stage was reached when eye and hand were left to their own cleverness, with no guide to help them. So the work was more of an art – a very fascinating art – than a science; and in this art, as I say, the brain had its share. A good wheelwright knew by art but not by reasoning the proportion to keep between spokes and felloes; and so too a good smith knew how tight a two-and-a-half inch tyre should be made for a five-foot wheel and how tight for a four-foot, and so on. He felt it, in his bones. It was a perception with him. But there was no science in it; no reasoning. Every detail stood by itself, and had to be learnt either by trial and error or by tradition.

This was the case with all dimensions. I knew how to "line out" a pair of shafts on a plank, and had in fact lined and helped saw on the saw-pit hundreds of them, years before I understood, thinking it over, why this method came right. So too it was years before I understood why a cart wheel needed a certain convexity although I had seen wheels fall to pieces for want of it. It was a detail most carefully attended to by the men in my shop; but I think none of them, any more than myself, could have explained why it had to be so.

Some things I never learnt at all, they being all but obsolete even in that primitive shop. To say nothing of square-tongued wheels – a mystery I still think of with some awe – there was the placing of the "tines" in a wooden harrow that remained an unknown secret to me. The opportunities of investigating it had been too few when cast-iron harrows, ready-made, banished the whole subject from our attention. I just learnt how the harrow was put together to be hauled over the field by one corner; but the trick of mortising the teeth – the "tines" – into it so that no two cut the same track – this was known to one elderly man but never to me. The same man also failed to teach me how to "line out" a wooden axle. Indeed, he forgot it himself at last. So it happened that when an ancient dung-cart arrived, needing a wooden axle for its still serviceable wheels, nobody was quite sure how to mark out the axle on the bone-hard bit of beech that was found for it. It was then that my rather useless schooling came in handy for once. With a little geometry I was able to pencil out on the beech the outlines of an axle to serve (in its clumsier dimensions) the better-known purposes of iron. Yet I have no doubt that the elderly wheelwright's tradition would have been better, if only he could have remembered it."

Making a tip-cart, at Fawley in Herefordshire, in 1937.

WHEEL-MAKING AND REPAIRING FOR COACHBUILDERS

In 1911 "Cooper's Vehicle Journal" featured a series of articles written by Charles Holmes, entitled "The Coachmakers' Handbook". I have extracted this section on wheel making and repairing from that text. In his introduction Charles Holmes says "The wheels used by coach makers are in many instances purchased from a wheel-maker, perhaps from a large factory, where nothing but wheels are made, and where machinery is largely used; but nearly all coachmakers have to repair wheels even in they do not make them."

The wheels used by coach makers are in many instances purchased from a wheel-maker, perhaps from a large factory, where nothing but wheels are made and where machinery is largely used; but nearly all coachmakers have to repair wheels, even if they do not make them.

A typical English wheel consists of a nave, some spokes, felloes and tyre.

The nave is a block of wood, being a section of a young tree (usually elm), say 12 in. long by 8 in. diameter, and the heart should be near the middle; a hole is generally bored through it lengthways of the grain to take out the heart, and the nave is dried for some years. It is then turned to the right size and shape, and morticed to receive the tenon of the spokes; these mortices all meet in the middle of the nave and are arranged alternately, some ½ in. in front or behind one another; this distance of the face of the spokes, one in front of the other, is called the stagger of the spokes. The nave being round and the shoulder of the tenon on the spoke being flat, they will not fit perfectly, so it is usual to pare the nave to make a flat seat for the shoulder of the spoke.

These mortices must not be cut square down into the nave, but sloping a little from the front to the back, according to the dish of the wheel, and alternately one more sloping than its neighbour, so as to bring all the tang ends of the spokes into line. When the spokes have been driven into the nave, the tangs are cut on the end of the spokes, and are usually round and as large as the spoke will admit, and more to the front than the back of the spoke. The felloes are now cut to the right size and holes bored to fit the tangs and dowel holes bored and dowels fitted to hold the felloes together; the dowels should not be long or the dowel holes deep, as we do not wish to weaken the felloes at the ends. The tang holes are often made slightly oval towards the outside of the felloes, the long diameter being length ways. The felloes are now driven on and the tangs wedged; of course, the wedges stand crossways of the felloes, as in the other direction they would easily split the felloes.

Before the spokes are driven into the nave it is usual to fit nave hoops on the nave to prevent it splitting; sometimes temporary nave hoops are used, and after the wheels are hooped these are removed and the permanent nave hoops are put on.

All measurements of a wheel should be made from the centre, and to do this a peg is fitted into the centre of the wheel, and on the middle of that is screwed or nailed a long lath, to revolve freely like the finger of a watch. With the aid of this lath the bottom of the tangs of the spokes has been marked to a true circle; the felloes, however, are cut to a circle rather larger than the finished wheel, because when the tyre is put on it will force the ends of the felloes down (that is, towards the nave), and for this reason, before the tyre is put on, the ends of the felloes should not touch one another on the inside edge, but ought to be 1/16th in. to 1/8th in. apart on the outside. If the ends of the felloes fitted perfectly one against the other before the tyre was put on, then when the tyre was put on the felloes would only touch at the outside edge, and would gape open on the inside – this would look very bad and would admit wet into the felloes.

The wheel is fastened down to the wheel plate or platform; this is a circular iron plate, say 6ft. 6in. in diameter, and well dished, the centre cut away to receive the nave. The smith gets the tyre to a uniform red heat and drops it over the wheel, and as soon as it is in place slacks it either by lowering the whole platform into water or by pouring water over it. The wheeler watches the joints of the felloes, and if they are not closing properly a light blow on the face of the tyre will generally close them properly.

If the wheel is rather too much dished a blow from a sledge hammer on the face of the tyre opposite to each spoke will force the feet of the spokes into the nave and thus reduce the dish; this should not be overdone.

After hooping the wheels the tyres have to be drilled, taper holes to suit the rivets, and the felloes dressed off and finished, the tyres then riveted; a washer called a burr is fitted over the thin end of the rivet and takes its bearing on the felloe.

Then the axle bush must be let in true to the centre of the wheel; if there is no machinery to do this the wheeler cuts away the wood out of the nave by means of a large V chisel called a buz, and a large gauge, and having placed the axle box in position, proceeds to wedge it quite fast, driving the wedges round the box and into the nave, the wheeler has to swing the wheel from time to time, that is put it on a spindle and spin it round and watch the tyre to see that it runs true; if the front of box were a very little too near one side of the wheel and the back too near the other, the wheel could not run true.

When the box is secure and the wheel true, the wheeler cuts off the wedges level with the ends of the nave, and the wheel is ready to go into the painter's hands.

A wheeler requires fewer tools than either the body maker or carriage maker. The following are those generally required:—
2 saws, jack plane and smoothing plane, 3 spoke shaves, 1 Jarvis, mortice chisels, paring chisels, gouges, hammers, axe and adze, V chisel or buz, brace and bits, bradawls and gimlets, spoke holder or cramp, draw knife.

A coachmaker often buys his spokes ready turned and with the feet already cut; but sometimes the wheeler has to get them out from rough cleft spokes; these are reduced first with an axe and afterwards with a draw knife and spoke shave, and finished off with a Jarvis (this tool, rather like a very large spoke shave or rowter, has a plane iron which is shaped to the cross section of the side of a spoke). The spoke holder or cramp is fixed to the bench and holds the spoke between two lathe centres, so that it can be turned round as required.

There are many modifications of the ordinary wheel, such as the wheel, in which a flat band is shrunk on the nave and the spoke holes morticed through it, then a malleable cast iron band with the mortice holes in a raised ring is shrunk on the wood nave, and is called the Warner nave, or the ring containing the mortices is sunk into the nave called Sweet's concealed band and sometimes the naves are cast iron, and sockets are fitted on to the felloes to receive the spokes.

The felloes themselves are not unfrequently of bent timber, usually half rims, and then small felloe plates are riveted across the two joints of the felloes. In America, where these rims are often made of hickory, which splits more readily than English ash, a fine brass screw is screwed into the felloe from back to front on each side of each tang hole to prevent it splitting.

The tyres are now often of indiarubber, and then steel channels are shrunk on the wheels and the indiarubber tyres are forced into them; these rubber tyres are either wired on or clincher – the clincher channel section is as Fig. 27, and the tyre is forced in with a kind of blunt chisel or caulking tool and a hammer, or in a machine where the caulking tool is operated by a lever. The wired-on channel section is as Fig. 28, and the rubber tyres may have one or two wires in them, which may be welded together or screwed together by a right and left pipe nut, or fastened in some other way.

We have mentioned the dish of the wheel; this is caused by morticing the spokes into the nave, not so as to stand upright, but every spoke leaning to the front of the nave, and they are bent a little more when the tyre is put on.

Note: See page 44 for illustrations of Clincher and wired-on tyre channels.

When there is some stagger on the spokes, as in most ordinary wheels, the dish is measured from the front surface of the front spoke to a straight edge held on the tyre just above the nave.

If the axle is set so that the bottom front spoke is upright, then the wheels will be further apart at the top than on the ground by four times the amount of the dish; this, of course, gives room for a wider body than could be used if the wheels were upright.

Another advantage of a dished wheel is that the mud from the road will be thrown away from the body. The wheel is also stronger to resist a blow on the outside, such as that caused by driving against a curb stone, and the iron tyre will keep tight longer. For it is evident that a wheel running on an ordinary road receives a number of light blows from the road (because the surface of the road is slightly uneven); these repeated blows beat out and lengthen the tyre, the spokes now become more upright and thus increase the diameter of the wheel.

A dished wheel obliges us to set the axle arms sloping downwards towards the nut end, and if the tyre is a flat one, the front edge of the tyre touches the road first and wears away sooner than the back.

To obviate this, wide tyres are generally coned, that is hammered, and thus lengthened on the inside edge after they are shut, or slightly bent edgeways before welding them up.

The wearing down of the front edge of the tyre is often very evident when the wheels come in, after one or two years' work, to have the tyres contracted, and the wheeler usually puts them on with the former front edge to the back.

The American wheelmakers often make their very light wheels upright, and the bodies are usually narrow compared to the width of the axles; but in the first instance these wheels were made to run on soft roads, so that the tyres are not hammered out so rapidly as on our roads.

No part of a carriage is so likely to need repair as the wheels. In the first place the tyres have lengthened and become loose; this is usually remedied by cutting a small piece out of the tyre and welding the tyre up into a rather smaller circle, this is called contracting the tyre. Then the felloes may split at the tang holes or where the dowel hole weakens the end of the fellow, on the chin of the fellow may break off. Some splits may be screwed up, but more often new felloes will be required. Then the back of the felloes may have worn slightly round, owing to the wood having worn more against the back of the tyre and the front of the tyre and less against the middle of the tyre, and, again, as the felloe is supported in the middle by the two spokes, but is not supported at the ends, it will be bent to a quicker curve than at first; to remedy these defects the felloes will be planed down in the middle to make them true from back to front, and the outside or back reduced in the middle and the inside reduced at the chins.

The ends of the felloe will have come apart from one another inside -- the wheeler says they are open at the chins -- and to cure that the felloe is slightly shortened, and it is evident the wheel will not be quite the same size as before unless we put in one new longer felloe. It is often a better plan to make the wheel, say, ½in. lower by cutting down the spokes a little at the tangs.

Of course, if all new felloes are put on there is no difficulty in keeping the wheel the same height as before.

Some spokes may be broken at the tang, or where they fit into the nave, or they may be only half broken at the foot; this can be found out by drawing the spokes a little way out of the nave, when, if anything is wrong, a crack will be visible on the back of the tenon by the foot, and any damaged spokes discovered must be replaced by new ones.

The nave may have split, and sometimes that split is repaired in common work by taking off the nave hoop, carefully sawing the split and fitting in a piece of wood, with the grain to run the same way as the grain in the nave. In good work a split nave should be replaced with a new one, and if the split is a circular one, it is very little use trying to repair it, though it is sometimes filled with white lead and then pinned or beaded.

After repairing a wheel it must be swung to see that it is true: put the wheel on its axle, the axle being jacked up if on the carriage, or put in the vice, then put a mallet or block of wood on the floor, and turn the wheel slowly round; if the edge of the tyre at one point of its circumference touches the

mallet and at the opposite point is ½in. clear of it, or more, it is evident that the bush is not true to the wheel, and must be wedged. A wedge driven into the front of the nave forces the nearest point of the circumference back, and if driven into the back of nave it forces the nearest part of the circumference towards the front. If, therefore, you mark on the wheel the place where the tyre is too far to the front, and drive a wedge into the nave between that point and the bush, you will cure, or partly cure, that defect, and if you drive a wedge in at the back of nave, but on the opposite side of the nave, you will increase the effect, so with the two wedges you can get the bush true. Although we talk about forcing the rim of the wheel back, it is the bush that we have moved, in order to get the axis of the bush at right angles to the plane of the wheel.

Sometimes when the axle is jacked up we find that the wheel in revolving comes nearer to the ground at one place, and that shows the bush requires moving nearer to that part. The centre of the bush ought to be the centre of the wheel.

Of course, no wheel is perfect, and the amount of imperfection permitted varies in different shops; but a wheeler who takes a pride in his work will always endeavour to make his wheels as nearly true as possible.

A PIT-FRAME FOR WHEEL MAKING

The article opposite is re-printed from the magazine "Work -- An Illustrated Magazine of Practice and Theory for all Workmen, Professional and Amateur" dated June 29, 1889. The general use of frames to this design is confirmed by the photograph taken in the 1950s, of Dixon's workshop at Devizes, Wiltshire.

WORK

An Illustrated Magazine of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

[*All Rights reserved.*]

VOL. I.—No. 15.] SATURDAY, JUNE 29, 1889. [PRICE ONE PENNY.

PIT-FRAME FOR WHEEL MAKING.

BY PETER WILLIAMSON.

A WHEEL-FRAME or pit is a necessity to a wheelwright's or coachbuilder's shop. How a wheeler could make a wheel without this indispensable article it would not be easy to imagine. There are three differently made frames, but all are nearly similar in appearance, the only difference being the way in which they are fitted up. The primitive frame was, indeed (as its name implies), a pit-frame, and is still, I believe, used in some parts of the country yet. It is something similar to a sawyer's sawing-pit, only, of course, very narrow. A pit was dug 5 ft. long by 1 ft. wide, and 1 ft. deep; four posts were driven in, and the top was made exactly the same as the one I am going to describe 2 ft. high from the ground.

But this pit being a fixture in the shop or yard, it took up too much room, so, therefore, it has given way to a more convenient one, which I will describe, and show you how to make one exactly the same as I have, and on which I have made hundreds of wheels. It can be carried about by two men, and when not in use and there is no room to spare in the shop, it can be put outside in the yard, as I have kept mine out in all weathers, in summer and winter; and it appears to be as strong (although it is not painted) as it was when first I made it years ago.

The top of the frame which I have has apparently been the trunk of an ash sawn in two, as the under part and sides are just a little round, where the bark has been peeled off. I merely mention this to show that the top only is required to be straight and square, and also the sides a little, but, if the top be all of one width, so much the better.

In the first place we shall require two long lengths of ash or deal. If of ash, it should be 3½ in. thick; if deal, 4 in. thick. These two pieces must be 6 ft. 4 in. long, 7 in. wide, and 3½ in. thick; two swords 2 ft. by 3 in. by 1½ in. of ash or oak; four legs, 2½ ft. high by 2½ in. square, also of oak or ash. These measurements are just as I have measured, so that you must allow for sawing and planing. Get your jack plane and smooth the two large pieces at the top and sides, also your swords. Then lay your large pieces or top on your bench both together in a line, put your swords upon the top, about 3 in. from each end of the large pieces, and mark with pencil each side of sword on the frame top.

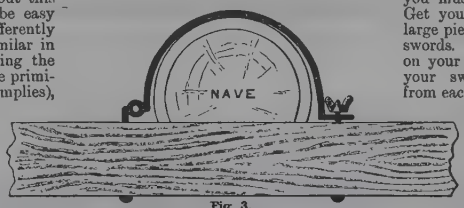


Fig. 3.

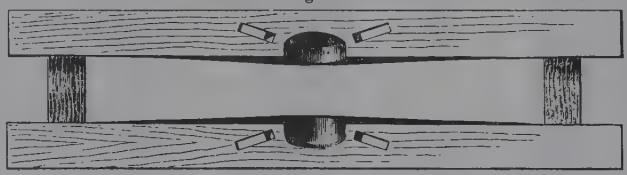


Fig. 1.

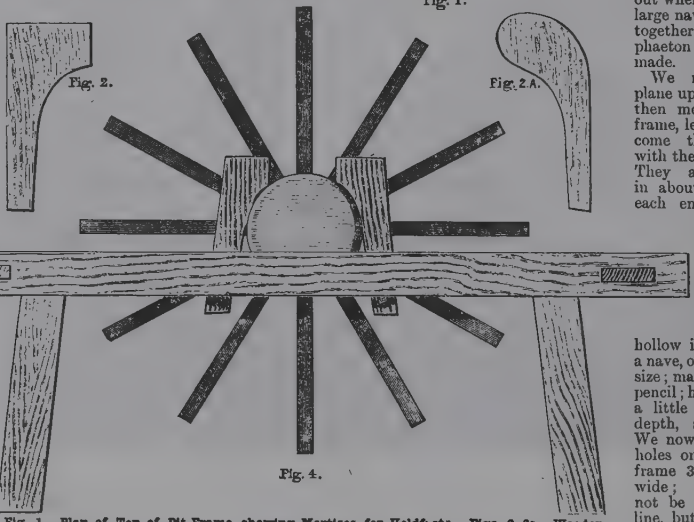


Fig. 1.—Plan of Top of Pit-Frame showing Mortises for Holdfasts. Figs. 2, 2a.—Wooden Holdfasts to hold Nave. Fig. 3.—Nave held on Frame with Iron Holdfast. Fig. 4.—Front Elevation of Pit-Frame, with Nave and Spokes in Position.

We now get the large piece and square down the sides from the pencil line. When we have served all the four sides alike, we set our gauge and mark for the mortise. This mortise must be 3 in. by 1⅛ in. wide: bore first with ¾ in. bit, then mortise out with a sharp paring chisel. Knock in your swords; do not fit them in slack, and they must not be fastened in the frame, as it sometimes has to be drawn out when mortising a large nave, or pushed together when a small phaeton wheel is being made.

We now roughly plane up the four legs, then mortise in the frame, letting the legs come through level with the top of frame. They are mortised in about 15 in. from each end of frame. You will see that the legs stand out all round. Now find the centre of frame, and hollow it out; or get a nave, one of medium size; mark round with pencil; hollow this out a little at its lowest depth, say 1½ inch. We now mortise four holes on the top of frame 3 in. by 1 in. wide; these must not be in a straight line, but slanting as Fig. 1. The space between the mortises

must be 6½ in. : these mortises are to be fitted with four holdfasts, as in Fig. 2, or 2A. These are of ash, the size of them being 20 in. long, full ¾ in. thick, 2½ in. wide at the foot, getting thicker and wider at the top. Instead of these holdfasts, some wheelers have an iron band or hinged clamp which fits half way over the nave to hold it fast in its place whilst it is being mortised. At one end there is a thumb-screw which, when unfastened, allows the nave to be turned round. These iron holdfasts (Fig. 3) are fixed where the fret or hoop will be when in its place on the nave.

The pit-frame which I have been describing, and which is shown in Fig. 4, is, I think, the one which is most approved of, as the wheeler can get at the wheel all round. The third kind of frame is made exactly like Fig. 4, only half of it being fixed to the wheeler's bench. It is a piece of deal or hard wood, 6 or 7 ft. long, with two legs mortised into the top of frame. This half of frame must be quite level with top of bench. Two swords are then fixed upon the top of bench and frame. A 2-in. slot 1 in. from each end of sword is mortised for thumb-screws to work in, or holes can be bored in the sword every inch or so to allow the screws to be put in to tighten and keep the frame together. Two holes are mortised in the bench, and also a little wood hollowed out, to bed the back end of nave. This kind of a pit-frame certainly is a very convenient one, as it does not take up much room, and when not in use can be put at one side until again required.

HOW TO BOX A WHEEL

(Reprinted from "Work – the Illustrated Weekly Journal of Mechanics" issue of July 4th, 1896)

SIR,—The term "boxing" applied to wheels means to put the case-hardened boxes inside the naves, and is a task necessary every time a cart is fitted with either fresh wheels or an axle.

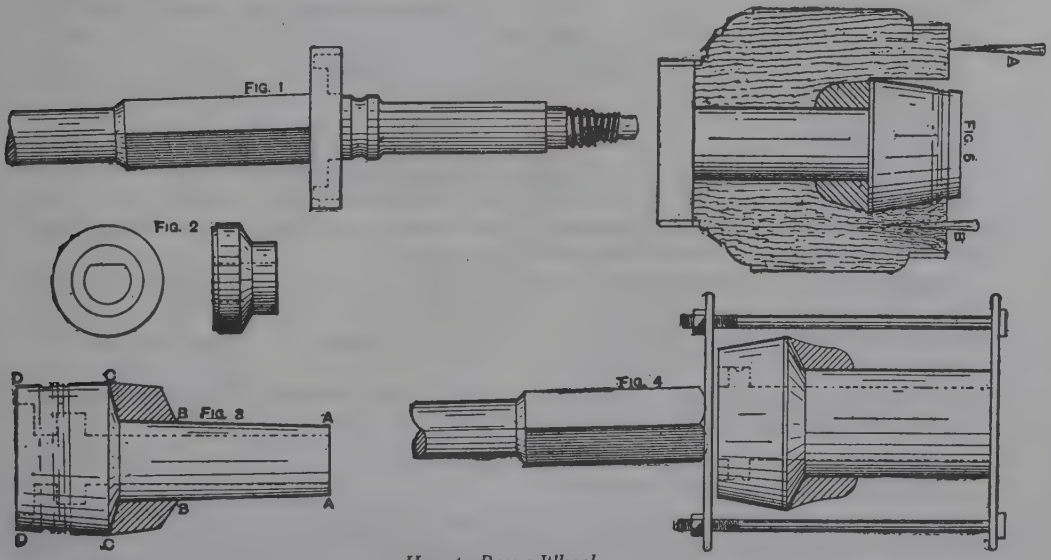
The tools required are few—an axe, a 3-lb. hammer, a rule, callipers and compasses, mallet and chisel, and some gouges being all that are wanted.

First gouge out the nave at the front and back to fit A and B (Fig. 3). Then measure from the back the distance between C and D (Fig. 3), allowing fully ⅛ in., and enlarge the hole that distance down to the diameter of the box at C. Cut a groove each side to accommodate the projecting pieces, drive in the box by placing a piece of 2-in. stuff under the hammer, and, if necessary, let in the cap at the front. Screw the axle in a vice, the bottom side up, and smartly swing the wheel upon it. Any deviation from accuracy will at once be detected. If the box has been driven in tightly and the wheel swings considerably out, it will be well to knock it out and ease the hole a little.

To true the wheel, rest the hand on a trestle, and, with a piece of chalk, gradually approach until some parts of the fronts of the felloes come into contact with the chalk. A wedge will be wanted between the chalk mark and the box at the front, and on the opposite side at the back. Finish by wedging tightly all round both back and front.

Old lancewood shafts make excellent wedges, being hard, tough, and springy; failing lancewood, use oak. The wedges should be 6 in. long, and about thirty will be required for a pair of wheels.

During the process of boxing—which is, of course, performed subsequently to tyring and hooping—the wheel is best supported on a low wooden block. A piece of old sacking is often very useful for wrapping round a box or tightening a loose nave hoop. Fig. 1 shows axle arm (Collinge's patent). Fig. 2, collet: front and end elevation. Fig. 3, box. Fig. 4, long bolt or mail axle, showing arm, box, and long bolts. Fig. 5, box (Collinge's) fitted inside nave: A, wedge started; B, wedge driven home.—H. SHEPPARD (*Bishop Stortford*).



How to Box a Wheel.

WHEEL CONSTRUCTION

This article is part of an essay written in 1881 by John S. Foggett, for the Worshipful Company of Coach Builders. It was reproduced in the Summer, 1977 issue of 'The Carriage Journal', which is published by the Carriage Association of America. Such reprints frequently appear in the Journal.

FIG. 1

FIG. 2

FIG. 3

Before the advent of machinery the profession of a wheelwright was one of some importance, and demanded no little mechanical skill and knowledge. The timber was all cleft and sawed from the tree by hand – with tools of a primitive description – yet these wheels were very durable. Albeit, the work of the human hand is in great measure uncertain compared with the mathematical accuracy of a machine.

Numerous reasons are advanced to explain why hand-made wheels are often more durable than those made by machine; but probably the most rational theory is that in many wheel factories the work is done by people who are ignorant of the properties of the materials they handle.

The proportions of a wheel are questions of grave importance as, if too light, it will not support the weight, if too heavy, the draught is increased unnecessarily.

Spokes. The three principal patterns are shown in the drawings; Fig. 1, the English sharp edge; Fig. 2, the German oval shape; Fig. 3, the ordinary American pattern. From the cross sections it can be seen that the latter closely approaches the round form. The neck, or throat, a, is dressed very narrow to give a lighter appearance and more elasticity.

In a spoke- machine the rough spoke is cut to the required length and thickness and turned in the copying lathe to conform to an iron pattern. Spokes thus made are identical.

The tenons are cut in another machine with adjustable cutter for different size of tenon, and then the spokes are polished in a third machine.

Hand-made spokes are shaped with a draw-knife and straightened with a plane, the neck being dressed out with a spoke-shave. The marks left by the plane are taken out with "a jarvis" – a hollow-bladed plane. The tenons are cut with a tenon-saw, and the spokes are finished with sand-paper.

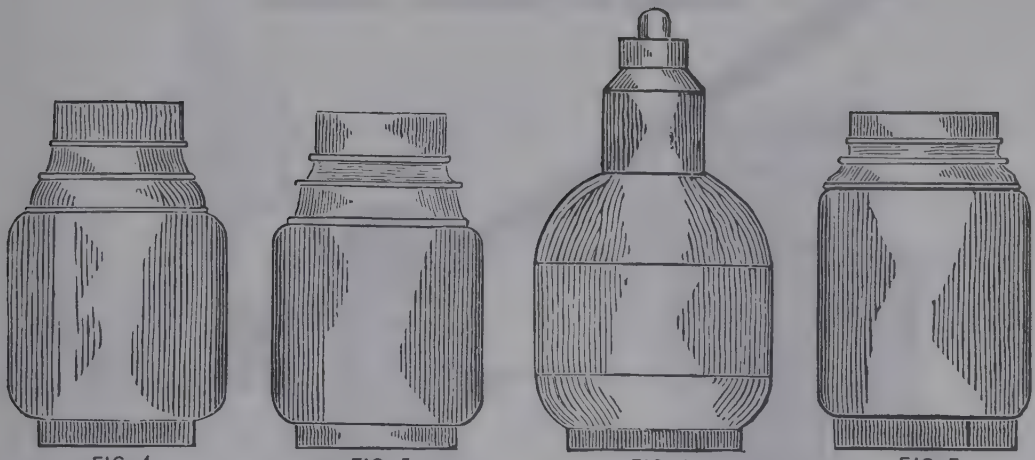


FIG. 4 FIG. 5 FIG. 6 FIG. 7

Stocks or Hubs. There is some variety of form in the typical hubs of different countries. Fig. 4 is the English; Figs. 5 and 6 the Russian; Fig. 7 the American.

Machinery has more or less taken the place of hand labour in the most difficult task, of morticing the hub. Fig. 8 illustrates a hand-driven boring and morticing machine into which the hub is fixed between two conical centres, the one on the right being tightened by a screw worked by the handle A. The conical centre on the left is fixed to a division plate with settings by which the mortices are accurately spaced. The hub can be tilted by means of the screw and wheel, C, and this tilt, or cant, determines the amount of "dish" given to the wheel. The mortices are first drilled out with the augur shown in the outline drawing, and then the augur is replaced by the patent chisel device shown in the machine, and this worked by the hand lever B.

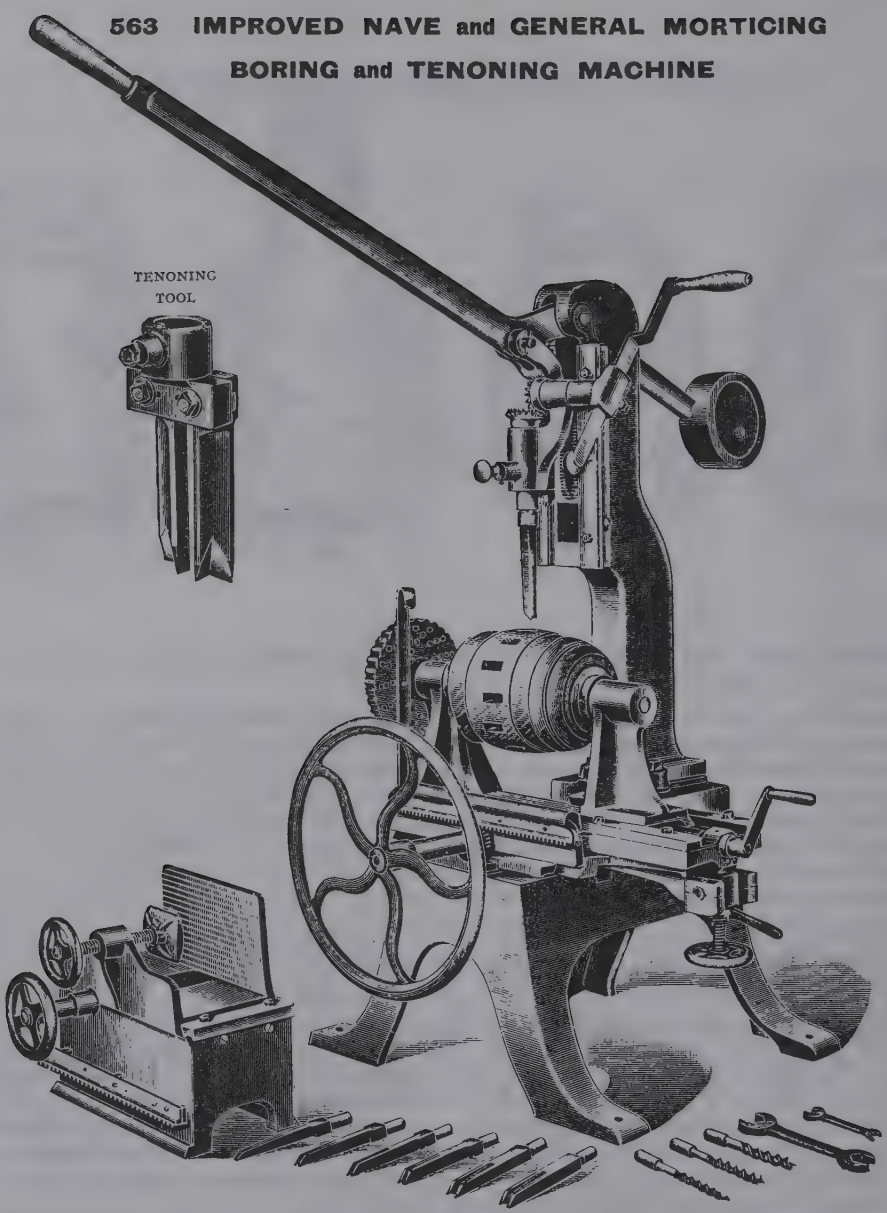
The hubs of hand-made wheels are usually turned in a foot-treadle lathe using the gouge and chisel. Calipers and compasses are used for accurate marking and gauging.

When the morticing is done by hand, the wheel-wright must pay close attention and have an intimate knowledge of the material. To prevent splitting an iron hoop is fixed on each end of the hub, which is firmly held in a pit-dog or a German cramp. Holes are first bored with an augur; then the tenon of the spoke is laid over the hole, and the size marked less 1/16th inch so that the spoke when driven will fit tightly. A "buzz", a kind of three-cornered chisel, is used to finish the mortice, and the desired inclination is checked by trying the spoke in the mortice and gauging it against a straight-edge placed against the end of the hub. It is an undecided question whether to take a small portion from each side of the mortice, or to cut the shoulders of the spoke to allow them to sit firmly against the hub. My own view is to cut from the strongest part, i.e. the hub.

Driving the Spokes. This is done by sharp blows from a mallet or hammer, the weight of which should vary according to the length of the spokes. A thin coat of glue is sometimes applied to the mortice and tenon, but this should not be necessary with properly seasoned wood. Driving should be performed in a wheel-pit where the workman has perfect control over both spoke and hub, and does not have to follow it all over the workshop floor.

The Tang. The next operation is to make the tangs, or outer tenons, which, if a machine is not available, is accomplished with a draw-knife. This cannot be done with perfect exactness, so it is necessary to insert a wedge into the end of the spoke after the felloe has been driven on to form a tight joint. An adjustable hollow augur is sometimes used for making the tang, which lessens the need for wedging.

563 IMPROVED NAVE and GENERAL MORTICING BORING and TENONING MACHINE



This Machine has been specially designed for Boring and Morticing Naves, but with the addition of ordinary Morticing Bed is equally well suited for Joiner's work. It is fitted with a dividing plate to suit naves with 10, 12, 14, or 16 spokes, takes in naves up to 15 in. diameter, and up to 15 in. long, and will mortice 6 in. deep.

The Bed is made to cant by wheel and screw so as to give any required dish to the spokes. It is fit up with direct Boring Apparatus, and it is advisable when morticing naves, owing to the hard nature of wood used, to bore the holes first; then finish by morticing in the ordinary manner.

For a small additional charge the Boring Apparatus can be fitted with fast and loose pulleys for power. Tenoning Tool can also be supplied if required.

When the Machine is required for ordinary Morticing, remove the Nave Morticing Bed, and substitute the ordinary Table.

Price	Complete with Boring Apparatus, 3 Self Coring Chisels and 3 Augers, viz. :—$\frac{5}{8}$, $\frac{3}{4}$, $\frac{7}{8}$ in.	£18 0 0
Extra	If fitted with ordinary Morticing Bed in addition to Nave Morticing Bed, and 4 extra Self Coring Chisels, viz. :—$\frac{1}{4}$, $\frac{5}{16}$, $\frac{3}{8}$, $\frac{1}{2}$ in.	5 10 0
,,	If Boring Apparatus fitted with Fast and Loose Pulleys for power...	0 15 0
,,	For Tenoning Tool, which will cut Tenons from $\frac{1}{8}$ to 1 in.	2 0 0

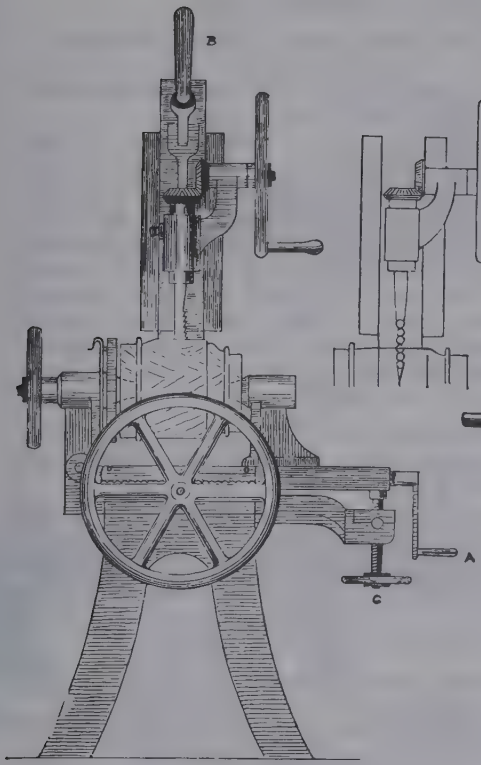


FIG. 8

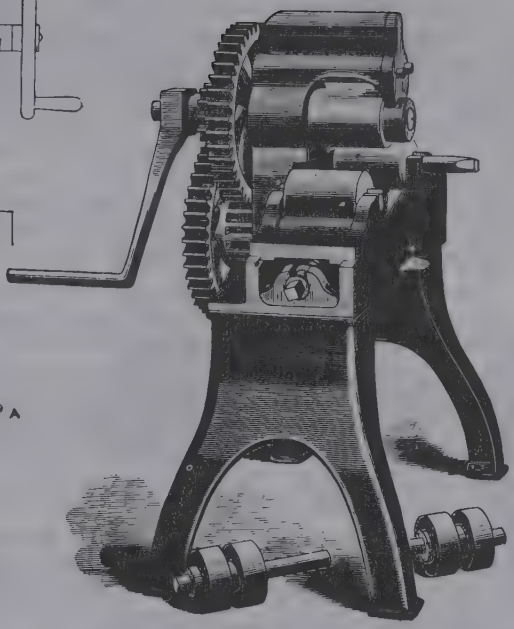


FIG. 9

Felloes. One felloe is needed for each two spokes; thus a 12 spoke wheel has 6 felloes, a 14 spoke wheel has 7, and so on. Usually the timber for felloes is roughly shaped before seasoning, and these rough felloes are refaced and cut to the required thickness by the circular saw. The felloe is "bellied out", that is the inside concavity is shaped, with an adze, with the work fixed in a felloe-block. The ends are cut to the proper bevel by placing the felloe on the circumference of the wheel and marking the ends with a straight line carried from the centre of the hub. A little is cut away on each side of the line so that, when driven and wedged, the joints may be tight on the inside of the rim and a little slack on the outside, say from 1/16in. to 1/8in. being allowed, and when the tire is shrunk on, this will form a perfectly close joint.

In most shops a machine is now used for planing the felloes, and it may be adjusted to cut a square cross-section or one tapered towards the tread.

Holes must now be bored in the ends of the felloe to receive the dowels which connect it to the adjoining felloes. This dowel should not be more than 2in in length to avoid weakening the felloe. Iron dowels are sometimes used.

The pivot stool is called into use for holding the wheel while the felloes are driven on.

Before the tire is fitted, all wheels should have their spoke ends cut away with a gouge, to prevent them bearing on the tire when the wheel is finished. Similarly, the spoke ends in the hub should not rest on the axle-box.

Hub Hoops. These are made of various widths, but it is only necessary that they should project slightly over the axle caps; thus the outer hoop with a Collinge axle might be 3in, but only 2½in. for a Mail axle. They are usually made from iron bar 1/8th in thick. The inner edges are slightly bevelled so that they will not split the wood fibers when driven on. They are put on slightly hot and immediately cooled with water.

TIRES

The modern hoop tire binds the wheel together and acts as a preservative against the concussion to which it is subjected in use. Hence the necessity of iron or steel for tires.

For bending the tire, a machine is preferable (the bar passing between rollers), Fig. 9, as the action is gradual and equal, but light iron bars of good quality are bent in the cold state, by hand, without damage, round wooden segments corresponding in size with the different felloes. Steel tires, if very strong, must be slightly heated for this operation. When bent the ends are placed in the fire and heated to a bright red, they are then upset* a little, and afterwards roughly tapered to scarfed with a fuller, and the tire returned to the fire. In order that both ends may be exposed equally to the fire, the hoop is laid on the flat, or at an angle of about 45^{o}; when a white heat is reached, the flux (if any is used) is sprinkled over the laps. The tire being withdrawn is placed rapidly on the anvil, one light blow being sufficient to cause the ends to adhere, when by further blows the whole is consolidated. During the process of welding, the edges of the bar bulge out, these should not be hammered back, as is a common custom, but should be trimmed off with a chisel.

Steel requires great care in welding, as it is very liable to cool at the point in contact with the cold surface of the anvil. This may be remedied by using instead a small square iron block, which can be slightly heated, and when securely fixed is used for light work.

In order that the tire may firmly bind the wheel and close up the joints of felloes, it becomes necessary to weld it up smaller than the wheel; practice alone can enable the smith to determine the exact size. This is evident in carefully examining a set of four hand-made wheels, in which there is seldom the same amount of jointway left in any two. A wheel with felloes should have 1/10in left at the top of each joint. This in a wheel with six gives us 3/8in. the circumference to be drawn up. Besides this, the construction of the wheel, whether light or heavy, must be considered.

The impossibility for any fixed rule to be observed is at once apparent, but the following sizes may be taken as representing approximately the allowance made:

IRON TIRE	DIAMETER	WELDED
1½in. by ⅜ in.	3 ft to 3 ft. 10 in.	½in. smaller than wheel
1⅜ in. by ½in.	4 ft to 4 ft. 10in.	⅝ in. smaller than wheel
1½in. by ⅝ in.	5 ft.	¾in. smaller than wheel

It will, of course, be understood, that the above applies only to wheels in which felloes are used. In the case of bent rims, little more than 1/8in. is necessary, and even less with very light tires.

After welding, the tire is laid on the wheel, and the position for rivet, bolt, or screw holes marked off with a pair of compasses.

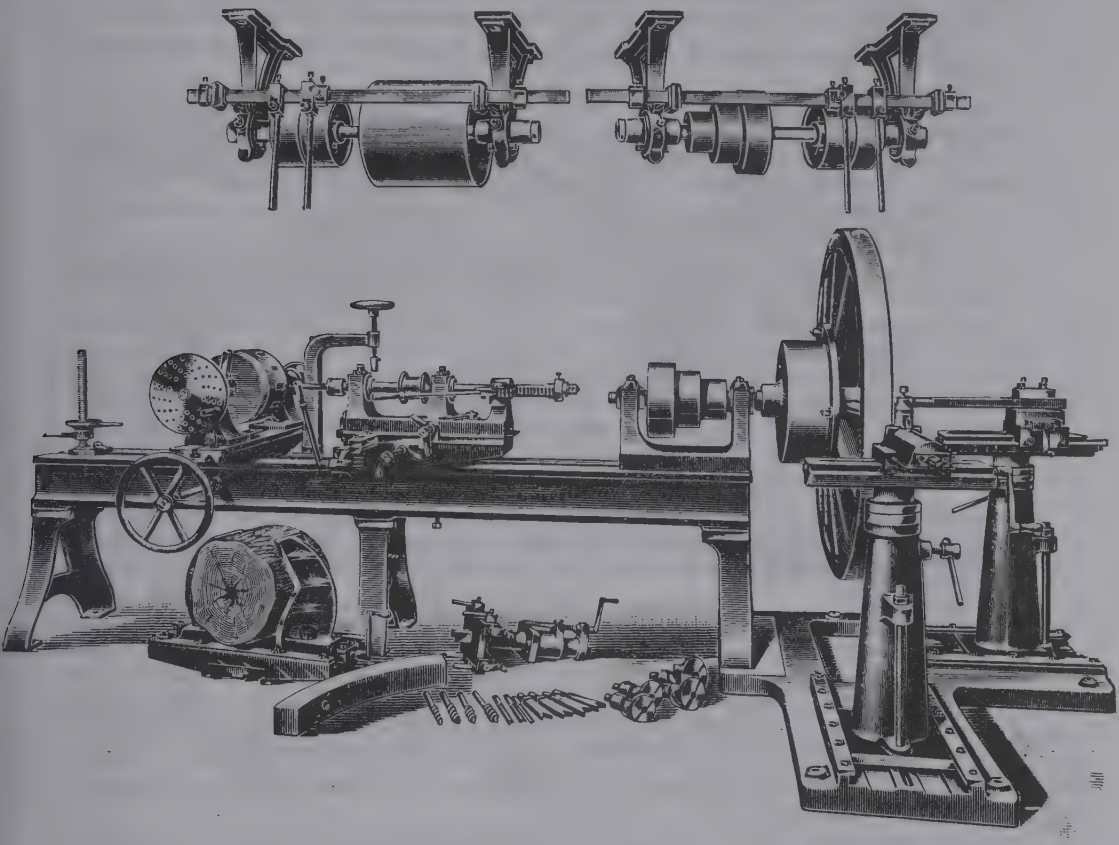
The number and position for the holes are matters of importance, but it is agreed that for felloes one near each end is necessary, and with rims, one for each space between spokes, except at the joints where the bolts of the rim plates are inserted.

Continued on page 38

The details of Wheelwright's machinery on the opposite and following pages are taken from a catalogue issued by Jonas Woodhead of Leeds, early in the 1900's.

1458 GENERAL WHEELWRIGHT'S MACHINE

For SPOKE TANGING FELLOE BORING HUB BORING HUB BOXING and WHEEL TURNING



This Machine has been carefully designed to do the whole of the work specified above in the best possible way, and we strongly recommend it to Coach, Van, and Wagon Builders and Wheelwrights doing a large business. It is very strongly made throughout and of the best materials, and is calculated to stand the hard wear and tear of heavy work.

It will bore centre holes in Naves, mortice Naves, tang Spokes, bore Felloes for spokes and dowells, and bore out Hubs for boxes; will also turn up rims of Wheels true on face and on sides, and turn out a perfect job.

The Morticing Heads are fitted with dividing plate for morticing for 10, 12, 14, or 16 spokes. The Slide for boring Hubs is indexed so that any required taper of hole can be bored. It is fitted with an improved instantaneous release nut, allowing the tool to be quickly withdrawn from the hole after boring.

The Sole Plate is fitted with two pillars, each carrying compound slides, one for turning the rim, the other for boring out the hubs for boxes. The Slide for turning rim has a traverse of 16 inches parallel to the rim, and 8 inches traverse down the face. The Slide for boring hub has a traverse of 7 inches, with a 4½ inches transverse traverse.

End of Gantry is fitted with fast head stock with 3-speed cone and face plate to which the wheels are clamped for turning up. Will take wheels up to 6 ft. 3 in. diameter. Brake is fitted as shewn on 1456 machine, page 264.

Machine is sent out with Countershafts fitted with suitable Pulleys, &c., Clamp for holding hubs for boring out centre hole, and 1¼ in. Boring Bar, 4 Tanging Chucks, 4 Boring Bits (¾, 1, 1¼, 1½ in.), 4 Rotary Morticing Bits, 4 Morticing Bits for squaring mortice ends (⅝, ⅞, 1, 1¼ in.), 1 Setting Bar, 4 Cramping Bolts, and a set of Spanners.

Other sizes of Chucks or Bits may be had if preferred, instead of sizes given, if stated when ordering Machine.

No.	Size of Driving Pulleys on Spoke Tanging Countershaft.	Revs. per Minute.	Size of Driving Pulleys on Wheel Boxing Countershaft.	Revs. per Minute.	Approx. H.P. required.	Approx. Weight.	Price as Illustrated.	If without Apparatus for Boring Centre Hole in Naves.
1458	8 × 4 in.	800	12 × 4 in.	150	5 Brake	46 cwt.	£92 15 0	£81 15 0

It will be found advantageous if the table of the drilling machine is fitted with a parallel vice, for holding the tire in position. When drilling a tire by hand, some difficulty is experienced in getting the hole quite straight, but if a twist drill, fitted with a centering chuck is used, the work will be satisfactory.

There are three agents employed in heating tires for contraction on to the rim, viz: gas, coal and wood.

The first method has been favourably received in America. It consists of placing the tire on a circular frame and subjecting it to the flame of gas burners, set in a circle, and adjustable to any size of tire. The inventor claims two very important advantages for his system, cheapness, not being so costly as coal, and an even distribution of heat all round the hoop.

Coal is used in some places, but care should be taken to select a coal as free from sulphur as possible.

Wood is generally used, and where it can be easily obtained it is perhaps the best fuel, though it ought to be dry.

The form of furnace must now be considered. The most efficient and useful furnace is built of fire bricks, and measures 6 ft. to 7 ft. high, 6 ft. to 7 ft. long, and 20 in. to 24 in. wide. To prevent the tires touching the fuel, and to obtain a uniform heat all round, two rollers are fitted to the inside, and are worked by a handle and toothed wheels on the outside. The rollers are places about 12 in. above the fire and 12 in. apart. The handle is usually worked in the ash-pit, below the level of the floor. When a tire is placed inside, it has a resting place on the rollers, these in turning cause the hoop to revolve and present its entire surface to the fire.

Another furnace fired from the back is frequently used, the tire being laid flat on the bottom, which is about 3ft. above the floor level. This furnace is not nearly so efficacious as the former, and could be somewhat improved upon by firing from each side, the fuel being placed in large cups or holders.

Diversity of opinion exists respecting the proper heat to give a tire, the controversy resting between the two heats technically known as "black" and "blood red". The former is said to be adequate with bent rims, and no water is required, but when the allowance for draft with felloes is made, a blood red heat is absolutely necessary, otherwise the iron will not expand sufficiently to allow its being placed upon the wheel. This involves the use of water to prevent the rim being burned, or charcoal is formed between the wood and iron, and in running, works out, and leaves the tire loose.

Water to be effective must be applied quickly. Walking round a wheel and pouring on water is therefore unsatisfactory.

Fig. 10 will probably serve to illustrate the most efficient appliance for this purpose. It consists of a large circular iron tank built into the ground; this tank is covered with an iron disc or platform, perforated with round holes, and planed perfectly true on the surface. The wheel is placed upon this and secured by a screw, an opening being made for the front of the stock, thus allowing the rim to rest on a true plane. The hand lever, a, is connected with a beam, f, which, when the former is loosened from its fastening, allows the platform to descend and submerge the wheel. This method is all that can be desired for ensuring an even and rapid contraction of the tire.

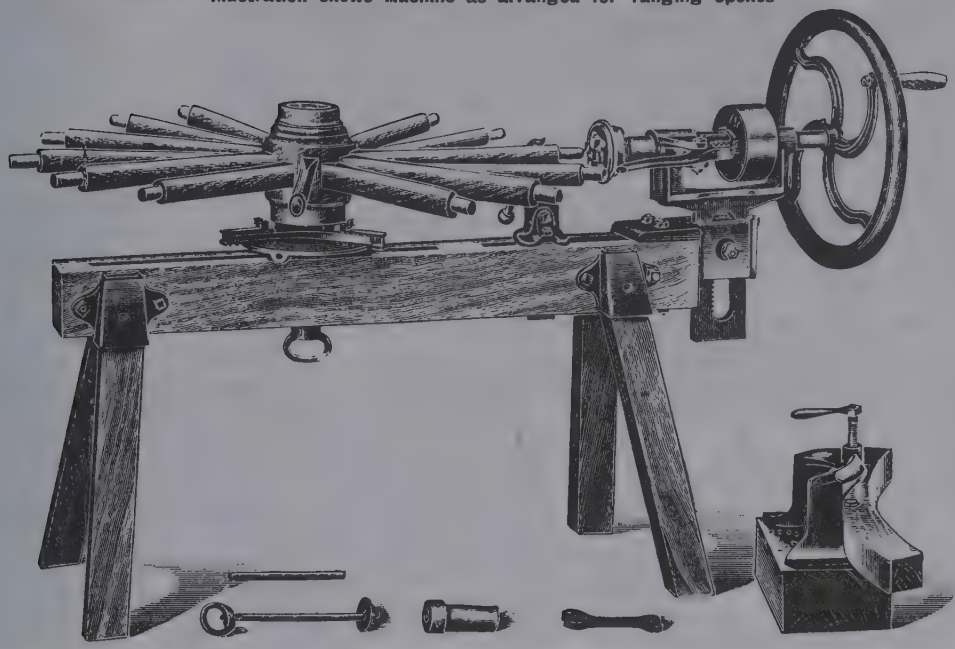
To preclude lateral working of the tire it must be secured to the rim, and this is accomplished by bolts, rivets, or screws.

Bolts may be used for heavy work, being fastened on the inside by nuts, but are unsightly. They can be adopted with advantage when a vehicle is required for a locality at some distance from a carriage manufactory, as a country blacksmith has little trouble removing them, and does not usually possess rivets.

Screws do not require a large hole as it is not necessary that they should reach completely through the rim. Great trouble will, however, be experienced in removing them, even if the heads are counter-sunk. Rivets, with counter-sunk heads and made from good flexible iron, are probably the best fastening that can be given to a tire; they only require a small hole, and when fastened, by being rivetted on to a small washer called a burr, on the inside of the felloe, they are neat and effectual. In London rivets only are used.

470 SPOKE TANGING AND FELLOE BORING MACHINE for Hand and Power

Illustration shews Machine as arranged for Tanging Spokes



With this Machine Tangs can be cut and Felloes bored in less than one-fourth of the time required by the usual methods, and the work is more accurately done than by hand tools. For Tanging, the Machine is set so that every tang must be of exactly same size, and of same length to the shoulder. The self centring grip plate for holding wheels ensures them being quite central on the frame. For Boring, the Felloes are each firmly clamped into exactly the same position, thus ensuring perfect accuracy of the holes bored. We strongly recommend the extra heavy fly wheel as shewn on Machine. The slight additional cost is soon repaid by the greater ease of working. A lad can drive the Machine even on the largest size tangs or holes The Star Augers are acknowledged to be the best tools for Tanging in the market. They are readily adjusted, and cutters are easily kept in order.

The head of this Machine is arranged with double bearings, and driving pulley for power on the spindle. The pulley is not at all in the way of working by hand, and acts as an additional fly wheel.

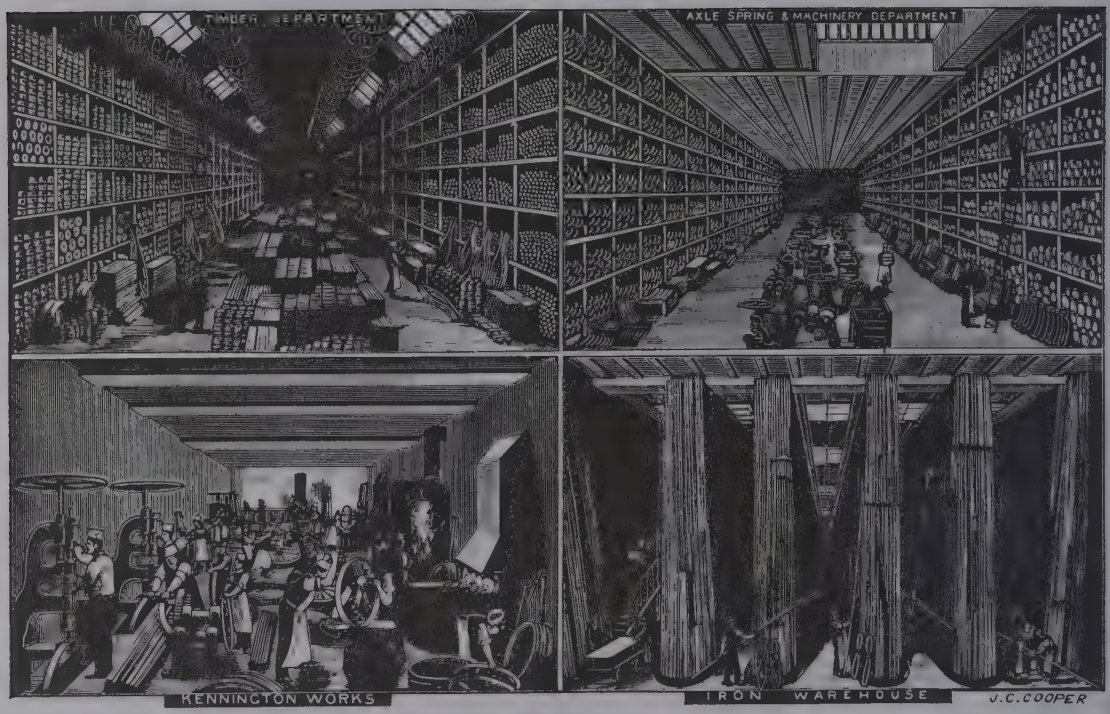
470E is very strongly constructed, and capable of taking the heaviest class of wheels. We recommend this Machine to Wagon Builders and all doing heavy work.

When worked by power the pulley should run 1,200 revs. per minute.

For Price of Boring Augers see page 260

No.		Size of Pulley	Ordinary Fly Wheel	Heavy Fly Wheel
470	With one Star Auger to cut Tangs from $\frac{7}{16}$ to 1 in. dia.	6 × 2½ in.	£6 12 6	6/- extra
470A	,, ,, ,, $\frac{5}{8}$ to 1¼ ,, ...	6 × 2½ ,,	7 12 6	6/- ,,
470B	,, ,, ,, $\frac{3}{4}$ to 1½ ,, ...	6 × 2½ ,,	8 12 6	6/- ,,
470C	With two Star Augers ,, $\frac{7}{16}$ to 1¼ ,, ...	6 × 2½ ,,	9 5 0	6/- ,,
470D	,, ,, ,, $\frac{7}{16}$ to 1½ ,, ...	6 × 2½ ,,	10 5 0	6/- ,,
470E	,, ,, ,, $\frac{5}{8}$ to 2 ,, ...	6 × 2½ ,,	12 7 6	6/- ,,

470 470A 470B 470C 470D will cut Tangs up to 4 in. long and bore to 4 in. deep and 470E up to 6 in. long and to 6 in. deep
Will bore Hubs ready for Morticing



THE WHEELWRIGHTS' SUPPLIERS

As I explained in the introduction nearly all wheelwrights depended on specialist firms to supply the components for their vehicles. There would have been very few village workshops which remained "self-sufficient" up to the late 1800's.

It is true that in some areas the wooden axle arm for farm vehicles persisted until that time enabling the wheelwright and blacksmith between them to construct all the components necessary for building a waggon. However, this was very much the exception.

The illustration above and the accompanying text on the opposite page are taken from a 1901 issue of 'The Coach Builder's and Wheelwright's Art Journal", while the advertisements on the following pages illustrate the range of items supplied to the trade.

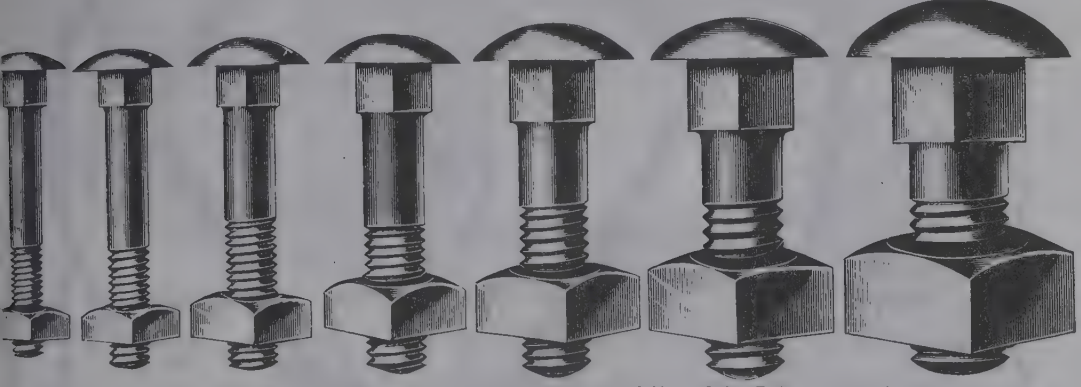
OUR ACCESSORY TRADES.

AMONG the many different firms supplying coach builders, the well known London firm of R. Wood & Sons, supplying timber and coach ironmongery, hold a prominent position, and their extensive works, situate in Brandon Street and Eltham Street, Walworth, are well worthy of an inspection. The premises occupied by these works are Nos. 95, 97, 99, 86, 86*a* and 86*b*, in Brandon Street, and Nos. 8 and 10, in Eltham Street, while they have other works in Doris Street, Lambeth, established in 1849, since which time the business has been advancing by rapid strides until it has reached its present vast proportions. Quite recently we paid a visit to these works, a general view of which is given in our illustration.

Through the chief entrance in Brandon Street, we came in view of five large stacks of bar iron and steel, suitable to the various requirements of wheelwright and smith in general, each stack was 75 feet long closely stacked with 17 feet lengths, among which were comprised all the well known brands, including special brands of Messrs. Wood & Sons, known as "The Brandon," also a special brand of mild steel with round and square edges. At a moderate computation we should say that these stacks represented an aggregate of not less than 3,000 tons. Passing these, we come to a room over 70 feet long and about 60 feet wide, well stocked with axles and springs by the best makers, scroll irons, and other such fittings, the floor above presenting a complete maze of wheels and wheel timbers of every size or height, adapted for pony carts or heavy farm wagons, and comprising both American and English produce. Here also were stored bent timbers of various descriptions, suitable to the requirements of coach builders or wheelwrights.

In some new premises in the course of construction at the back of the iron stores, on the ground floor, we observed a stock of about 30 tons of coach bolts of various sizes and kinds, No. 86*a*, is specially devoted, on the ground floor, to machinery, comprising drilling machines, tyre benders, portable forges, with every kind of tool required in a smith's shop. No. 86*b* is devoted, also on the ground floor, to coach ironmongery, brass caps and carriage fittings of various kinds. Over these two stores we come upon another extensive store of English and American made wheels, in the rear of which is another large store of wheel timbers, bent shafts, &c, in this department there are stacked some 200,000 felloes of various sizes

Leaving Brandon Street, we entered the recently added premises at Nos. 8 & 10, Eltham Street, where Messrs. Wood and Sons contemplate putting down sawing and bending machinery, at present, however, these premises are used for the further storage of timber, American spokes in cases, stacks of felloes, &c. Indeed, on looking round, we could see everywhere evidence of a large and ever increasing business, which we should point out here is carried on, on the ready money system, to which the proprietors largely attribute their success, giving as they do, to their customers all the advantages to which they are entitled by prompt payment. They buy for cash and sell for cash, and deliver their goods in their own vans to any part of London and its suburbs. They issue illustrated price lists and sheets, copies of which every coach builder should possess, and we have no hesitation in saying he will be able to study them to his advantage, comprising as they do, almost every thing he may require in the special department to which they refer, for the process of manufacture.



Illustrations shew the exact size of Head Shank and Nut of the Bolts we supply

Length	⅜	1	1¼	1½	1¾	2	2¼	2½	2¾	3	3½	3¼	4	4½	5	5½	6	6½	7	7½	8	8½	9	9½	10	11	12	13	14	inches
m. 5/16 in.	1/11	1/11	1/11	1/11	2/-	2/1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	per gross
¼ ,,	1/11	1/11	2/-	2/-	2/1	2/2	2/3	2/4	2/5	2/7	2/8	2/9	3/-	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	,,
5/16 ,,	2/8	2/9	2/10	2/11	3/-	3/1	3/2	3/4	3/5	3/7	3/8	3/9	4/1	4/4	4/7	4/9	5/1	...	...	...	...	...	...	...	...	...	...	...	...	,,
⅜ ,,	...	3/9	3/10	3/11	4/1	4/3	4/5	4/7	4/9	4/11	5/1	5/3	5/7	6/-	6/4	6/8	7/-	8/-	8/8	9/-	9/5	9/9	10/3	10/8	11/-	...	...	...	...	,,
7/16 ,,	...	...	...	5/1	5/4	5/8	5/10	6/1	6/5	6/8	6/11	7/1	7/7	8/1	8/6	9/-	9/6	10/-	10/6	11/-	11/6	12/-	12/6	13/-	13/3	...	...	...	...	,,
½ ,,	...	...	...	...	...	7/6	7/7	7/8	8/-	8/4	8/8	9/-	9/9	10/-	11/-	11/9	12/-	13/-	14/-	14/6	15/3	16/-	16/6	17/3	18/-	19/-	20/9	...	...	,,
⅝ ,,	...	...	...	...	...	...	...	...	...	13/-	...	14/-	15/3	15/9	16/9	17/6	18/3	19/3	20/-	21/-	22/-	22/9	23/9	24/6	25/3	26/-	28/9	30/6	32/3	,,

Carriage-bolts, as shown in the catalogue of Jonas Woodhead of Leeds.

JOHN STANSFELD, LIMTD.

12 to 22, GREAT GEORGE ST.,

LEEDS.

TELEGRAPHIC ADDRESS
STANSFELD.
LEEDS.

IRON
&
STEEL
MERCHANTS,
BENT
TIMBER
MERCHANTS,
COACH
IRONMONGERS.

EVERY
DESCRIPTION
of
WOOD & IRON
WORKING
MACHINERY
KEPT IN
STOCK.

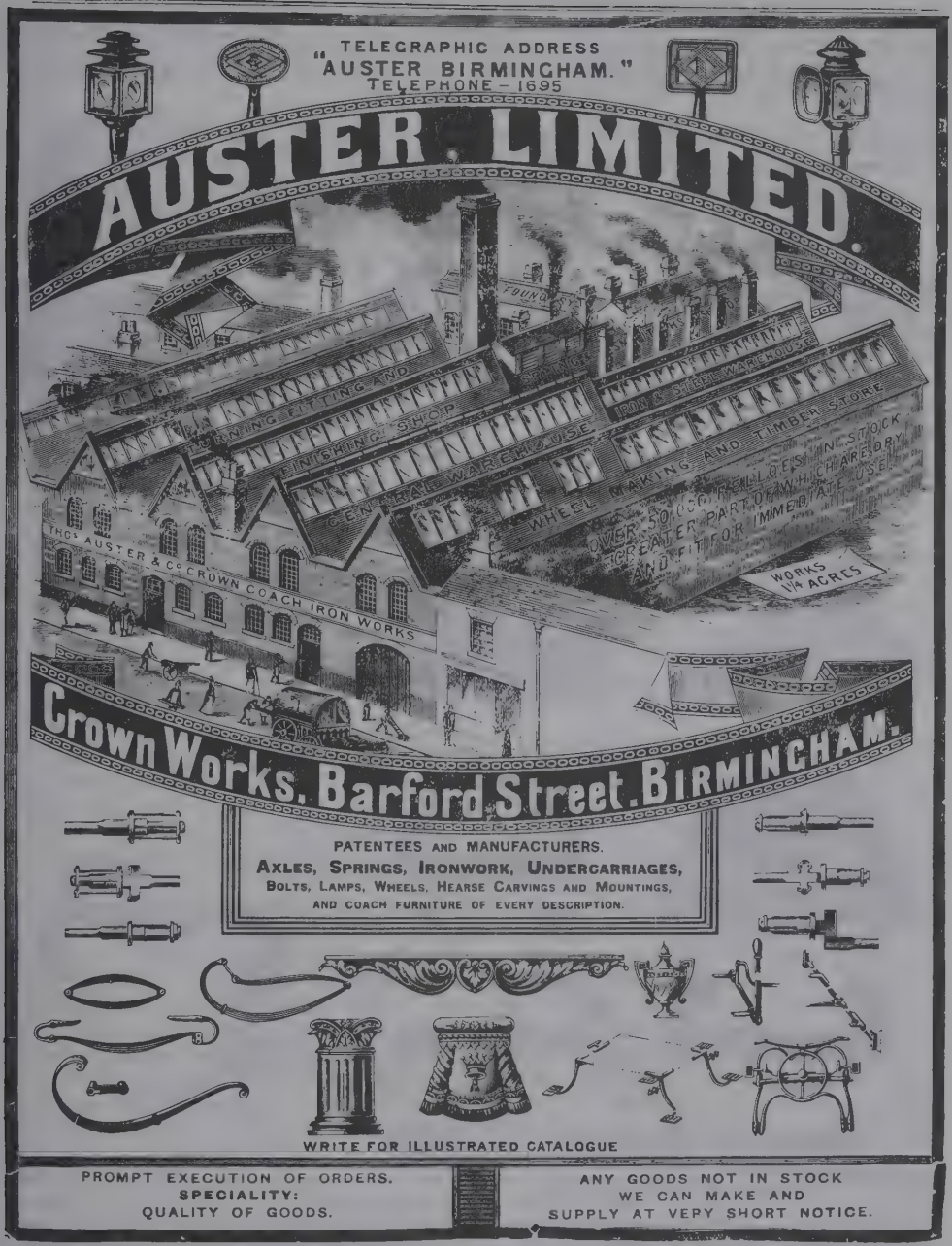
Warner Wheels
&
Rubber Tyres
Specialty.

Coach Builders
write for
Trade Catalogue.

AXLES,
ARMS,
SPRINGS,
SCROLL IRONS.

1,000
PAIRS
of
WHEELS
IN STOCK.

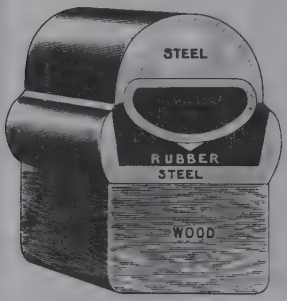
An advert from Cooper's Journal, March 1902. Note the examples of Drabbles, Collinge and Mail type axles. The bandsaw, drill and tyre bending machine are hand powered which might be used in a small wheelwright's shop.


TELEGRAPHIC ADDRESS
"AUSTER BIRMINGHAM."
TELEPHONE – 1695
AUSTER LIMITED.
TURNING, FITTING AND FINISHING SHOP
CENTRAL WAREHOUSE
IRON & STEEL WAREHOUSE
WHEEL MAKING AND TIMBER STORE
OVER 50,000 FEET OF SEASONED STOCK
THE GREATER PART OF WHICH IS READY AND FIT FOR IMMEDIATE USE
WORKS 1¼ ACRES
THOS AUSTER & Co CROWN COACH IRON WORKS
Crown Works, Barford Street, BIRMINGHAM.
PATENTEES AND MANUFACTURERS.
AXLES, SPRINGS, IRONWORK, UNDERCARRIAGES,
BOLTS, LAMPS, WHEELS, HEARSE CARVINGS AND MOUNTINGS,
AND COACH FURNITURE OF EVERY DESCRIPTION.
WRITE FOR ILLUSTRATED CATALOGUE
PROMPT EXECUTION OF ORDERS.
SPECIALITY:
QUALITY OF GOODS.
ANY GOODS NOT IN STOCK
WE CAN MAKE AND
SUPPLY AT VERY SHORT NOTICE.

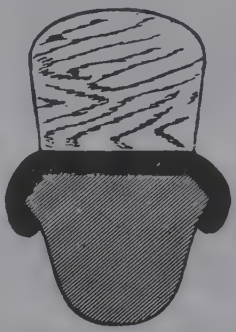
An advertisement from "Coopers Journal", April 1902. The objects at the bottom centre are machine made carvings for hearses.

STEEL CHANNELS.

THE introduction of new methods very frequently revolutionizes that branch of the trade to which they are allied, and it may be truly said that the advent of the rubber tyre has revolutionized the Tyre Bars out of all recognition. The flat iron and steel tyre bars have been always with us, and are with us still, and the only addition which has been made to them within our recollection, is that they are now made with one or two rounded edge overlapping the felloes. The introduction, however, of the rubber tyres has, as we have said, caused the tyre bar trade to be as diversified as it can well be, each particular invention requiring, as it does, its own particular steel channel. To emphasize our meaning in this direction, we give illustrations of some few of the channels now in use.

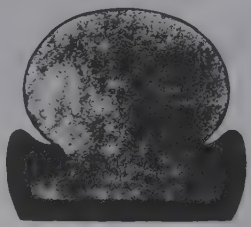


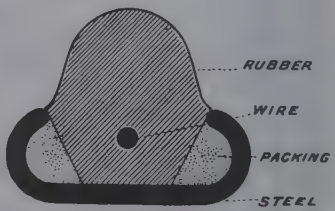
Channel of the Gare Tyre.


Channel of the Buffer Tyre.

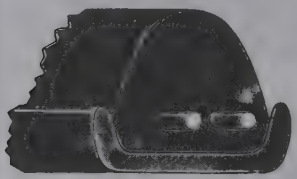
Channel for the Double Arch Tyre.

Channel of the Clincher Tyre.


Channel of the 20th Century Tyre.



Channel of the British Sansomian Tyre Co

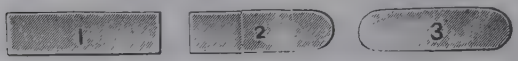

Channel of the Premier Tyre.

Channel made by the Kelham Rolling Mills Co., Ltd., Sheffield.

Channel of the NorthernSteel & Hardware Co.

Channel as made by William Oxley & Co., Park Gate, Steel Works, Rotherham.

Channel of the Wedge Tyre.



Northern Steel & Hardware Co.'s Tyre Bars.

A useful chart featured in a 1902 issue of "The Coachbuilder's and Wheelwright's Art Journal". The Clincher and the wired-on premier types gained most popularity.

THE BLACKSMITH'S SHOP

This article is taken from a magazine called "The Blacksmith, Horse-Shoers' Gazette, Wheelwright's and Cart and Wagon Makers Review", and appeared in 1901. The shop described might have formed part of one of the large and well equipped waggon and carriage building firms of that period. The photographs included in this chapter are from the catalogue of "Westyres" of Sydney, Australia and the illustrations of tyring platforms from the Jonas Woodhead catalogue.

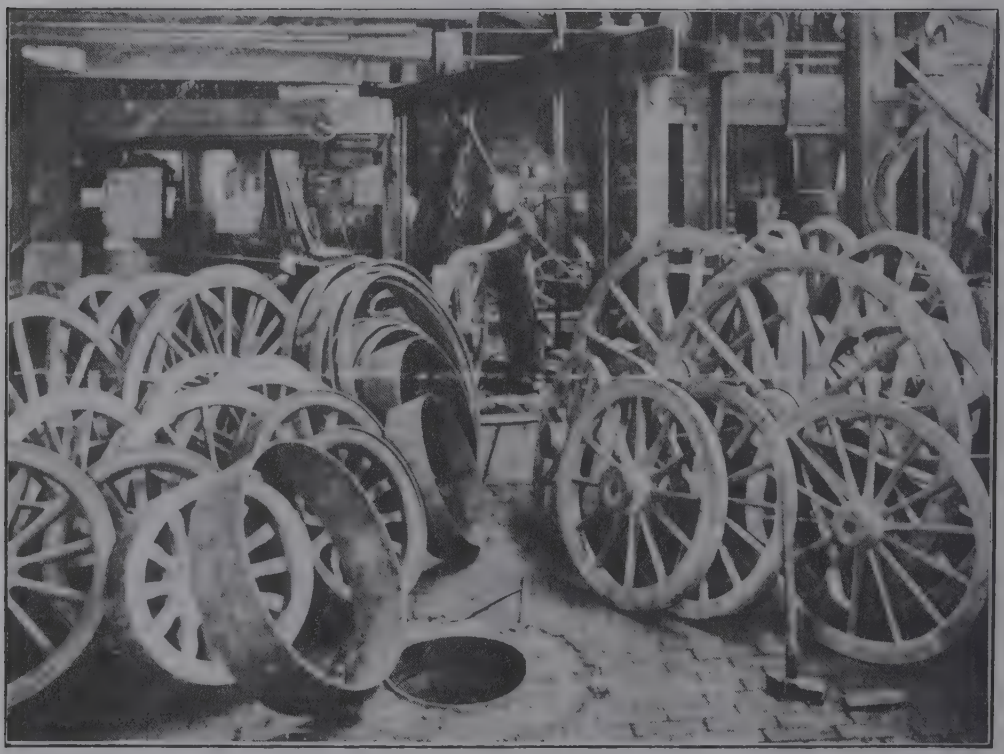
A great deal has been said, but too much can never be said, about the advantages derived from using improved tools, machinery, and above all, power, to help the blacksmith to perform his otherwise arduous task. The reading of suitable journals and papers on this subject is also a great help, and the reading of books devoted to these subjects of horseshoeing, blacksmithing and wheel-wrighting cannot be too highly recommended, especially for young men.

Blacksmithing, when done with the aid of modern machinery and appliances, actually becomes a pleasure compared with the toilsome drudgery of a few years ago. Not only does work under these new conditions become a pleasure, but it is invariably done better, neater, and with greater dispatch, and last, but not least, it more than doubles your income, because with the aid of modern tools a blacksmith can do twice as much work in a given time, and in a great many instances four times as much, and I dare say, in some instances, ten times as much work as his competitor, who employs the old-time methods. The installation of modern tools also gives the blacksmith more prestige, increases his business and pleases his customers; and he don't have to do the work any cheaper either, than the man who still uses the flail to thresh his wheat. In these times it would be well for some blacksmiths to remember that the survival of the fittest applies to them and their business as well as to all other branches of industrial enterprise.

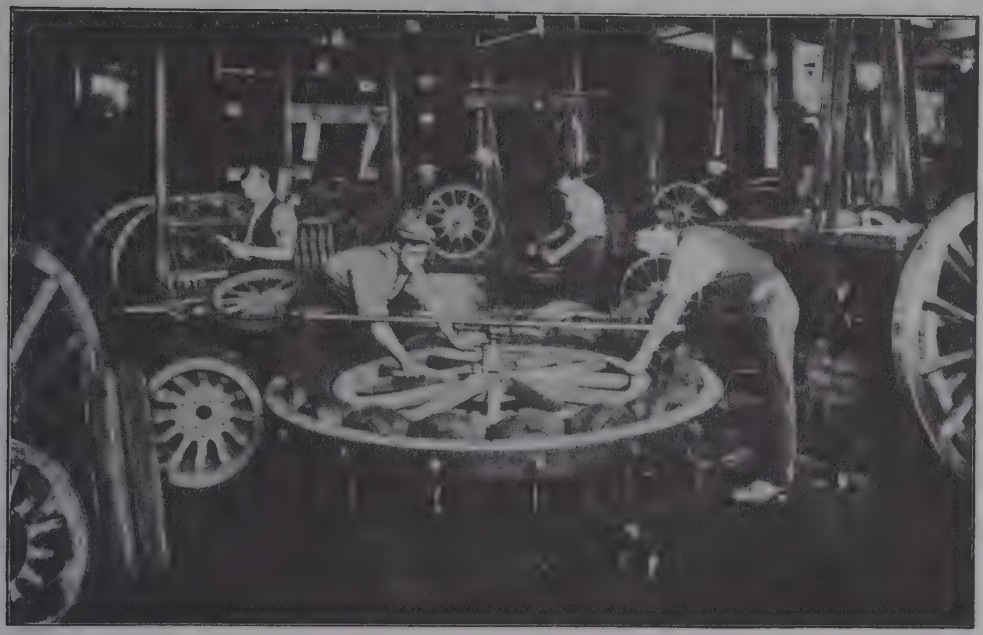
We cannot but help but marvel at the persistency with which some good sober men still cling to the ancient moss-grown methods they employed when they served their time. What they really need is to serve a short time in some good, up-to-date shop, and they would be quickly converted to the winning side. Let us suppose that one of these men that still cling to the old ways would pay a visit to a modern shop, and let us note how the conversion is brought about. We will suppose that this is a shop using power, the power being derived from a gasoline engine. He enters the blacksmith shop and the first thing that draws his attention is a man who is about to push the end of a $^{5}/_{8}$ by 3-inch bar of iron into a power tyre-bending machine. It enters and rolls steadily and easily under the rolls, and the blacksmith stands ready to take it out a true circle, and the only labour the smith had to perform was to introduce the end of the bar and remove the tyre when bent. He has three more; they are rolled in quick succession. Our knight of the wooden block and sledge, or at best a dinky little tyre bender not half large enough to do this class of work, is somewhat dazed already, because it was done in about five minutes. The smith now measures one of the heavy wheels, then measures and marks a tire and turns to the power shears, pushes the end of the tyre under the shears, gives a slight pressure with the foot on a pedal, and the surplus drops off as if it had been struck by lightning, and our man is amazed. It would have taken him and a helper in his shop (by the chisel route) quite a while to do that. The smith now takes the tyre to a low forge and turns on the blast; our man is getting his eyes open now. The smith measures and cuts another tyre while the first one is heating. Then calling a helper, the ends of the first one, which are now hot, are slightly scarfed, a welding heat taken, and it is welded under a power hammer. If they would have welded it on the anvil one man would have had to handle the heavy tyre while the other did the striking, while now the two men handle it and have it under perfect control. After the tyres are welded they are taken to an oil furnace, with the exception of the last one welded, which, upon being measured, after welding, was found a trifle large. This was returned to the fire for a few moments and is now taken out and put into a large tyre shrinker, a slight pull of the lever and the job is done.

Our man thinks to himself that's much easier and quicker than cutting and welding all over again. The tyres are now put into the furnace, the oil is lighted, and it is left to itself; no standing around and keeping wood up around the tyres in that machine. The wheels are now taken near a large tank filled with water, in which is an iron platform, on which one of the wheels is laid. In an incredibly short time the tyres are heated. The blacksmith and his helper take one out, drop it on the wheel; they don't have to pull and pound it on, for the tyre is a true circle as well as the wheel. The blacksmith moves a lever and the iron platform, wheel and all, sinks to the bottom of the tank, which quickly cools the tyre. The platform is now raised, wheel removed and the other three follow in rapid succession, and that part of it is done. Our man, who has been accustomed to heating tyres with a wood fire, then putting them on and throwing water on them with a tin can until the tyre shrinks enough to allow the wheel to be set up straight without the tyre falling off, and then carrying the wheel to a trough and whirling it in the same, has already resolved that the new way is the only sensible way to cool heavy tyres, because by his old method the best he can do he will always have a great deal of charred wood, which will gradually crumble away and cause tyres to become loose.

Also the great amount of time saved and the ease with which this heavy work is performed is of prime importance. The wheels are now taken to a power drill, and four holes drilled in each for felloe plates, but the drilling doesn't require any exertion to speak of on the part of the operator. Our man is thinking in the meantime of his little old horizontal drill, and he gets that tired feeling in his arm just to think of it. The wheels are all drilled in about the time it would have taken him to drill one hole. The tyre bolts are now put in and the nuts run on with a tyre-bolting machine, which pleases our man immensely. He thinks to himself, my wrench is not in it with that tool. The ends of the bolts are now cut off with a bolt clipper, which does easy and smooth work. Our man notices that the ends of the bolts don't need filing when using one of these tools. He always has to file the ends after worrying them off with a chisel and hardy.



No 4 – The big West's patent Hydraulic Tyre Setter.



In the Motor Room, No. 2 West's patent Hydraulic Tyresetter in foreground.

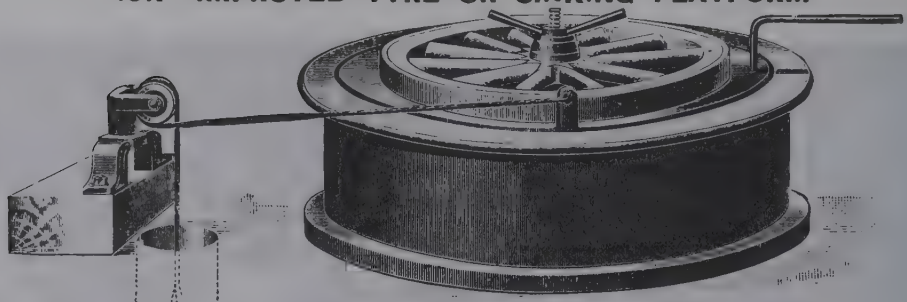
The hydraulic machine above has a superficial resemblance to the tyre platforms illustrated overleaf but, as the text explains the principle of operation is completely different.

The job is now complete. It was all done so quickly and easily that our man has decided he is learning something here to his advantage, and determines to put in some more time here. He sees a man working at a vice; he is cutting a thread on a $^{5}/_{8}$ -inch rod. He is using one of the best make of screw-plates. He runs it down once, and has a perfect, sharp thread, and it was done so easy; a great deal easier than one of the old-fashioned plates would have done it. He would have had to go over it at least twice, if not three times, and even then the thread would be rough and broken, because the old style of dies do as much crushing as cutting. The man having finished the rod, asks our man if he has ever seen a cold tyre shrinker at work, and receiving a negative answer, invites him to look on, as he is about to use one on a set of light wagon wheels.

Our man is only too glad of the opportunity; accepts the invitation with thanks. He notices that although the tyres are loose, the spokes have not been pounding on felloes yet. This customer has his tyres set in time, thinks he.

A wheel is laid in position, fastened and the power turned on. Our man still has his doubts, although he sees that something is happening to that wheel. The man turns off the power, and asks him if he thinks the wheel has dish enough. He looks over the wheel, and seeing it is practically straight, answers that it would be better to have a trifle more dish in it. The power is turned on again for a moment and shut off. He looks over the wheel again, and sees that the dish is just right. The look of doubt on his face has changed to one of astonishment and admiration. The wheel is removed and shown to him. He looks it over, and even taps it with a hammer. It rings like a bell, and he pronounces it "O.K.". The other three are now set in rapid succession, and that job is complete. It only took about ten minutes to do it, and it would have taken our man, in the old way, about two hours to do it.

1617 IMPROVED TYRE OR SINKING PLATFORM



This Sinking Platform has been greatly improved, and is now fitted with a Balance Gear to assist in raising and lowering the Plate. Can be readily worked by a boy. The rise and fall is effected by three Rollers running loose on inclined planes.

The Tank is one solid piece of Cast Iron, so that leakage of water is entirely eliminated. A plug is provided for letting water out.

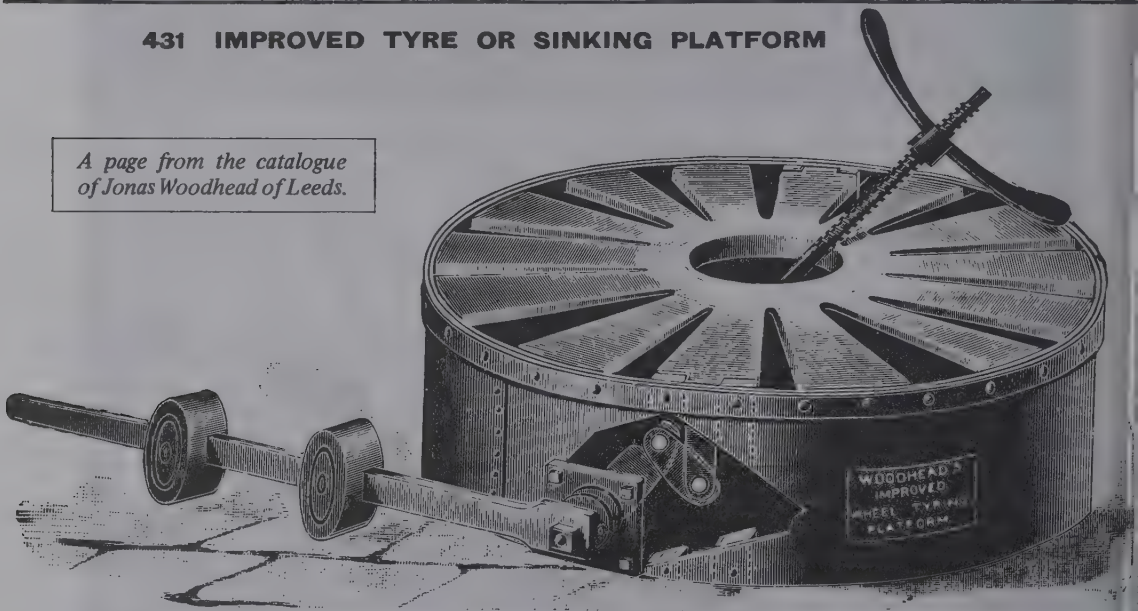
When the correct position of balance bracket has been ascertained, take a turn with the steel rope once round the pulley.

	Suitable for Wheels ...	5 ft. 0 in.		5 ft. 6 in.		6 ft. 0 in.		dia
Complete with Lever and Holding Down Screw as illustrated ...	Platform to sink 6 in. deep	26 cwt.	£25 0 0	28 cwt.	£29 10 0	30 cwt.	£38 5 0	each
	,, ,, 9 ,,	27 ,,	26 5 0	29 ,,	30 15 0	32 ,,	39 10 0	,,

If with Turned Plate ... 5 ft. 0 in. £3 0 0 5 ft. 6 in. £3 15 0 6 ft. 0 in. £4 10 0 extra

431 IMPROVED TYRE OR SINKING PLATFORM

A page from the catalogue of Jonas Woodhead of Leeds.



This Machine, although rather higher in price than some others on the market, is, we consider the cheapest in the end owing to the speedy manner in which wheels can be tyred by it, and the great saving of labour effected. The water only requires changing once in 12 to 18 months, according to the quantity of Tyres put on. A plug is provided for letting water out.

The Platform is in one solid casting, 5 ft. 4 in. dia., with 14 arms well supported by ribs underneath. The Wrought Iron Tank is 5 ft. 8 in. dia. × 2 ft. 4 in. deep. Strong Angle Brackets are bolted to Platform, and these work in the grooves at opposite sides of Tank. A strong Steel Shaft runs across the inside of the Tank to which are connected two Knuckle Couplings for raising or lowering the Platform. The Steel Lever is about 9 ft. long and complete with two heavy Balance Weights which can be instantly adjusted, so that a strong boy can work the Machine easily, even for heavy wheels.

The Wheel can be dropped under water for a moment immediately the Tyre is in position, thus preventing burning of felloes, and can be brought to surface again for examination and final adjustment before allowing Platform to plunge to full depth.

The Machine is self-contained and requires no fixing whatever. Approximate weight 26 cwt.

Can be supplied either with Plain or Bevelled Plate Bevel 2 in. Bevelled Plate sent unless otherwise specified.

431	Complete with Two Holding Down Screws $\frac{7}{8}$ and $1\frac{1}{4}$ in. dia.	£38 0 0
431A	,, ,, ,, ,, ,, ,, and Turned Plate	42 0 0

We recommend the Turned Plate for Light Wheels and High-class work generally

The workman now invites him to accompany him to the punch, as he has some work to do there. There are ten ½-inch plates lying on the floor, ten $^5/_8$-inch holes have to be punched in each plate. The workman puts in the punch and die needed and adjusts a guide to have the holes all the same distance from the edge. He now places one of the plates under the punch, touches a pedal and the punch sinks through the plate as if there had been nothing there. All the holes are quickly punched; in fact, the whole operation only consumed twenty-five minutes, while it would have taken our man and a helper by his method of hot punching, even if he was using one of his once famous Clevis punches, about four or five hours to do the same job; and even then the work wouldn't have looked near as well, besides he and his helper would have eaten their dinner in the sweat of their brow, while the man that did the job on the power punch was as fresh and cool when the job was done as when he commenced.

A wagon is brought in at this juncture with a broken axle. The body is blocked up, the wheels removed and the bins removed from the clips with a socket wrench in a bit-stock. Another wrench that beats my wrench all hollow, thinks our man.

The axle is removed and heated in one of the forges. Our man thinks to himself, if I could only rest while my iron was heating, how much better it would be for me. The axle is scarfed and welded under the power hammer. The job is done very easily and very quickly; the same as everything else in this shop.

He now ventures on the other side of a partition that runs through the shop, and finds himself on the shoeing floor. The same absence of bellows here. The blast is controlled by a little slide in the pipe. The man at the first fire is turning up some heel-calks on a set of No. 6 shoes. He notes the quickness and ease with which this is done, and vows that a foot vice is just the thing. The man on the floor is trimming the hoofs of a heavy horse, on which the shoes are to be fitted. He is using a pair of hoof shears, and the way he wades through that overgrown hoof is a caution; a couple of strokes with a rasp after he goes around with his shear completes the job. Our man thinks to himself, what a fool I have been all these years to twist and yank off hoofs with my pinchers and buttes.

A little further on he sees all kinds of rubber shoes and pads piled up on shelves. He asks one of the shoers if they use very many of these pads. He answers that they are coming more and more into use, as the horseowners are commencing to recognize their great virtue. He explains that existing conditions in our large cities, such as brick and stone pavements, are unnatural footing for the horse when shod with iron shoes, and the hard pounding and uncushioned shock soon ruin their feet and limbs and render them worthless. But in wearing the rubber pads it gives to the horse a natural footing, because every step is cushioned as nature intended it should be. Our man is satisfied that he has learned something here, and now passes on to the wood shop.

A man here is boring out a hub in a hub-boring machine. After boring it, which seems to take but a couple of minutes, he sets the box. No cutting and trying with a chisel made out of a file and a half hour's work. This box fits the first time. A little further on a man it cutting the tenons on the spokes of a wheel he has just fitted. He is cutting them with a little machine that he fastens to the spoke; all he has to do is to turn a crank, when the tenon is cut back far enough. The machine automatically stops cutting, so it isn't necessary to measure and mark the spokes, and then grunt while you cut the tenon with a small tool in a bit brace, and then, after all, get the shoulder crooked. And the little machine does it so much quicker, too.

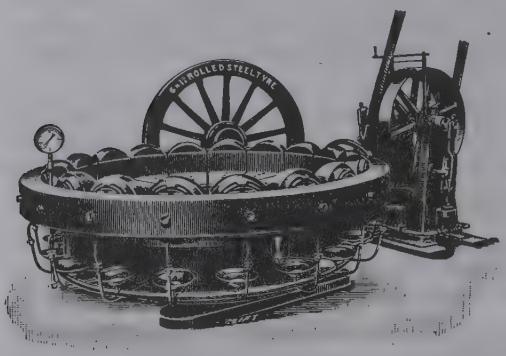
Our man now watches some quick work which is being done on a band saw, and then turns to go. Just before he passes out of the side door, he sees the source of all the ease and rapidity with which work is performed here. It is the gasoline engine; it occupies very little space and needs no engineer to stand around it all the time. He goes away thoroughly converted, and convinced that he can't go on in the old way any longer, because he knows now that it don't pay, and he makes a solemn vow that even if he can't have an engine and heavy power machinery at once, he will at least have the best hand and foot machinery and tools that he can buy.

"MODERN TYRING PLANT"

(Reprinted from 'The Blacksmith', December 1901.)

—:o:—

THE satisfactory tyring of wheels, whether constructed of wood or iron, is a problem that has had much attention given to it by engineers. The disadvantages of the old method of shrinking a hot tyre on to a wooden wheel are manifest; the contact of the hot metal with the wooden felloe chars and damages the wheel in one of its most vital parts; the immersion of the wood in steam and water as the tyre is cooled off is very detrimental, and the difficulty of obtaining exactly the amount of "nip" required together with the im-



possibility of regulating it when once the hot tyre is on and the contraction has commenced, form some of the principal disadvantages of this method from the point of view of high-class work; while the labour involved in removing, cutting and shutting a slack tyre before it can be replaced, as well as the damage to paint, etc., caused by the operation, form a strong condemnation from an economical point of view.

The idea that mechanical or other means might be devised of sufficient power to contract the metal composing the tyre *cold* is not by any means new. We believe that a machine for this purpose was introduced by Mr. J. B. West, of Rochester, New York, as long as twenty years ago and was experimented with at the Ordnance Factories but found unsatisfactory. The idea of this original machine was to place round the tyre a flexible steel band of great strength, the ends of which were drawn together by mechanical means, sufficient power being developed to compress the metal of the tyre and give it enough permanent set to nip firmly on the wheel. This arrangement was found feasible for very light work only, and, though numerous attempts have since been made to attain this end by purely mechanical means, no mechanical tyre-setter has yet been placed on the market that has in any way fulfilled the requirements of such a machine.

A good tool for this purpose, and one that can be economically used by the trade, must combine:—

1. Great power.
2. Compactness and convenience for handling wheels in and out.
3. Capacity for a large range in diameter of wheel.
4. Complete and instantaneous regulation of the amount of compression of tyre.
5. Accurate distribution and direction of pressure on the tyre surface.
6. Speed in working.

In spite of the non-success of his first efforts, Mr. West was convinced that the problem might be solved, and, as the results of several years experiments, abandoned mechanical means entirely and produced a tool of immense power actuated solely by hydraulic pressure. He introduced it into England five years ago and it is now well known to the trade as "West's Hydraulic Tyre Setter." The principle of the machine is simple: eighteen hydraulic rams are attached to the inner side of a steel ring of immense strength, these rams are actuated by a pump and fed from a central distributing chamber so that an equal pressure is maintained in each, and are so arranged that the wheel and tyre being laid in the machine, the tyre is grasped by the rams surrounding it and the metal compressed until it firmly encloses the wheel which it surrounds. The failure to accomplish this result by any purely mechanical process has been due to the difficulty of devising any means of developing the immense power necessary for the cold compression of the tyre bar at a speed which would give it any practical value.

The ingenious adaptation of hydraulics hit upon by Mr. West has completely overcome this and the amount of work that can be done in his machine is only controlled by the rapidity with which the wheels can be handled; we have seen expert workmen hoop as many as thirty heavy wheels in an hour with one of these machines while with light wheels and tyres that can be easily handled, the number can be nearly doubled. An idea of the immense power required may be gathered from the fact that to compress and firmly set a 4in. x 1in. tyre on a 5ft. wheel takes a pressure of 20 to 25 cwts. per square inch of tyre surface, and, as the surface of a tyre of this description has an area of 720 square inches, it follows that the enormous total pressure of 900 tons is developed in the machine.

The increase of pressure is, however, under complete control, and the release absolutely instantaneous so that the most delicate wheels can be hooped by this process with an accuracy that cannot be attained in any other way; while hoops too large to handle hot—except at great labour and expense—can be dealt with with equal accuracy and expedition, the cost of building the plant forming the only limit to the size of wheel and section of tyre that can be contracted in this way. One of the largest types of machine constructed by the West's Tyre Setter Syndicate at their Bradford

works and now in use in the shops of Mr. Werner Geub, at Cologne has a capacity of wheels up to 6ft. 6ins. in diameter in the wood, and Mr. Geub has recently contracted with it some tyres 9ins. wide x 1in. thick, while the smallest machine constructed by the firm will take sizes down to 3ins. diameter and hoops ¼in. x 1-16in.

Since the practicability of compressing tyres cold with sufficient economy and accuracy to make the tyre setter a valuable investment for any up-to-date works has been demonstrated by the increasing number of firms adopting its use, much attention has been devoted to a careful examination of the effects of the cold treatment upon the metal of which the tyre is composed; and a number of careful and independent tests have been carried out, not only by the patentees, but also by some of the leading scientific engineers, and the tests department of the Government Ordnance Factories. The results obtained in all cases are practically the same and go to show that the material when compressed within the limits necessary for practical working, i.e., about 1½ per cent. of its length, is considerably improved.

Tests taken after compression, shew an increased limit of elasticity, a higher tensile strength, and a greater bending resistance, while within the limits given there is no tendency to crystallization. It is a remarkable fact that the longitudinal compression of the tyre does not produce any increase in its other dimensions but the density of the material is increased, and its consequent hardness; and this increase in density takes place in a marked manner towards the skin of the tyre, improving its wearing power in a high degree. This is borne out by the actual experience of one of the principal London Omnibus Companies who found after careful comparison extending over a year that the life of a tyre set *cold* was from ten to fifteen per cent. greater than that of the same tyre contracted hot.

For artillery wheels or any other wheels of the Madras or similar patterns, the advantages to be obtained by the adoption of these machines is at once evident, and this has been speedily recognized not only by the British but by all European military authorities and the system is now at work in no less than twenty-five of the leading arsenals and ordnance factories in Europe, and the War Office authorities are employing a portable type of machine for the repair of their transport and artillery wheels in the field. Striking evidence of the way in which this system has superseded the old-fashioned method is to be found in the fact that with, we believe, one small exception, the whole of the immense number of wheels on the gun carriages and transport wagons of the South African Field force, whether built in England or America, have been tyred cold by West's system.

The inital outlay necessary for the installation of a hydraulic tyring plant forms the principal obstacle to its universal adoption by country wheelwrights and those doing a local trade. The cost of construction of this class of machinery destined to develop such enormous power is necessarily high as it entails the employment of materials of the highest class obtainable and the most careful workmanship throughout. This, however, has also the advantage of reducing the wear and tear to a minimum and ensuring a long life to the machine. For any firm having a large tyring trade of their own or situated in a district where a repairing trade is to be done, we know of no better investment than one of these machines. The cost of putting on new tyres is reduced to at least one-sixth of the old-fashioned method estimating the latter on the most favourable basis, and it costs no more to hoop one wheel than to hoop twenty while the machine is always ready and can be at work at a moment's notice.

For repair work the saving is much greater. It is in fact almost impossible to compare the two systems, but as it is unnecessary to remove the tyre from the wheel or even take out the rivets—provided the wheel is sound—in order to contract it cold, and as no damage is done to the paint during the process, it is well within the mark to put the cost of the modern process at one-twentieth of the old-fashioned method. To the customer in a busy time, there is also the recommendation that his tyres can be tightened *while he waits*, and there is no need for him to leave his cart at his wheelwrights for an indefinite period, an advantage that in itself is sufficient to bring the tyre-setter into great prominence.

Many patent tyres also that are now coming into use cannot be set by any other process, and we were recently shewn a pair of driving wheels for a heavy motor van that, owing to their peculiar construction, had exhausted the ingenuity of more than one of the largest firms in the Midlands in the matter of tyring, and were only sent to the makers of the tyre setter as a last resource: the machine, however, made an excellent job of them, and they are at the present moment in active use.

Mr. Thorneycroft has fully recognized the value of this system for motor work in a very able paper on the subject recently published in a contemporary. We notice that he strongly advocates the use of tyres *set cold* for motor work.

The utility of the process is not, however, confined to wooden wheels only, the tyre of an iron wheel can be set with equal ease and facility, and we understand that some of our leading portable engine makers intend installing plant of this description for use in their shops. Up to the present some 350 of these machines of various sizes are in use and their employment by the large American firms of agricultural implement builders is almost universal. We would suggest to some of our English firms in the same line that this is one more labour-saving appliance that it would well repay them to examine carefully.

Our illustration shows one of the West's Patent Tyre Setter Syndicate's latest pattern No. 6 machines

E. FARNELL & SONS,

VICTORIA WHEEL WORKS,

HALIFAX, Yorks,

And BIRKENSHAW SAW MILLS, near BRADFORD.

MAKERS OF

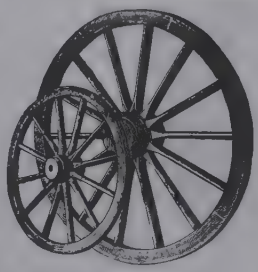
Ordinary Wood and Warner Wheels,

Tyred and in the Wood,

For—

CARRIAGES.	GIGS.	LURRIES.
LANDAUS.	HANSOM CABS.	FLOATS.
BROUGHAMS	CABS.	SPRING CARTS.
PHAETONS.	BUSES.	HAND CARTS.
CARS.	VANS.	TRUCKS.
DOG CARTS.	WAGGONS.	MOTOR CARS, &c
PONY CARTS	CARTS	

RUBBER TYRED WHEELS

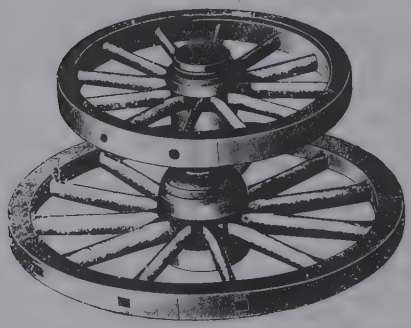


Any size made to order in a few hours.

Largest stock of Wheels and Wheel Timber in the Country.

Springs, Axles, and Bent Timber.

PRICES ON APPLICATION.



An advertisement which appeared in "The Coachbuilder's and Wheelwright's Art Journal", 1906. A technical point of interest is that even on machine made wheels like these, square spoke mortices in the fellies were sometimes provided – see the wheel at lower left.

A WHEEL MANUFACTURER – "WESTYRES"

I am grateful to Bill McCook for the loan of the original catalogue from Westyres of Sydney. The firm seems to have had a very well equipped but rather congested workshop!

Native Australian timber was used i.e. Iron bark for spokes and naves and New South Wales Blue Gum for fellies.

No. 1 – Nave mortising machine.

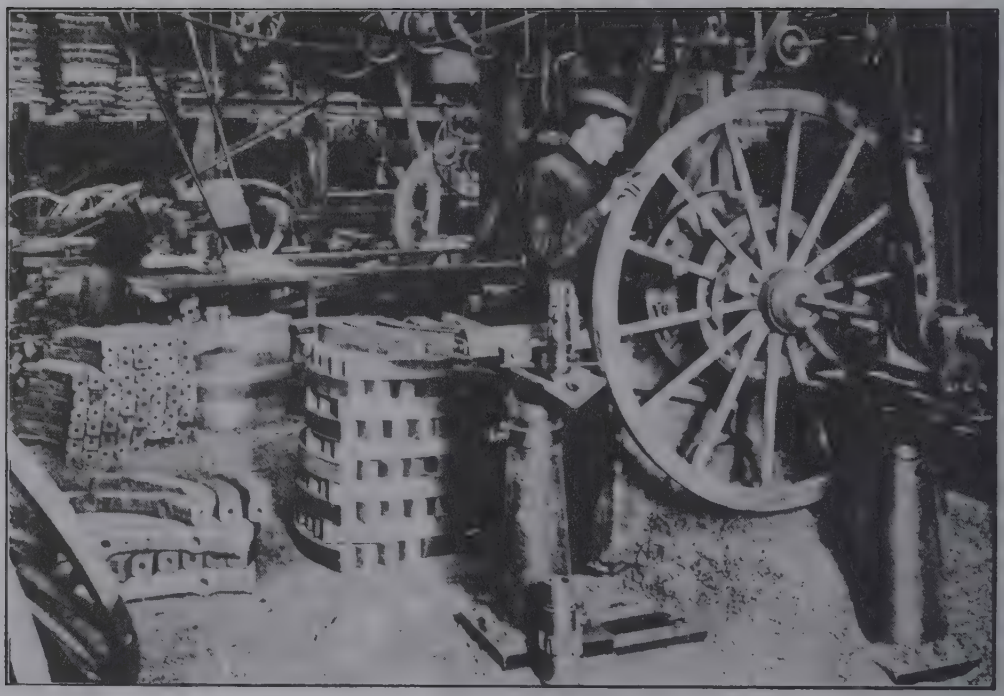
Naves are machine-mortised. All mortises exactly alike and made for spokes to fit. Spokes footed to suit mortises and for a given wheel all alike.

With shouldered spokes, shoulders on back spokes are specially bevelled to suit stagger. Tangs cut parallel with the face of wheel and shoulders square to afford a perfect seat for felloes.

Felloes are bored radially and parallel with face and fit tangs tightly. They are made high at the joints so that the wheel will be a true circle with close joints inside after tyring.

Tyres, if required compressed on by West's Patent Hydraulic Tyre Setter which makes the perfect job and leaves the wheel clean, the tyre everywhere square with the face. and neither chars nor bakes the wood.

If required tyres can be coned, that is uniformly bevelled, as is usually done on military wheels.



No. 3 – Wheel lathe and nave borer and other machines.

HOW WESTYRE WHEELS ARE MADE

With the illustrations accompanying, we show some of the more important parts of our plant and manufacturing methods.

No 1 shows the big mortising machine. This machine mortises naves of all sizes for straight or staggered spokes, with either tapered or parallel tenons.

No 2 shows the spoke driving machine, which has capacity for work over a wide range of sizes.

No 3 is the wheel lathe used for boring out for boxes and facing spokes for hub centres of motor and military wheels. In the same picture can be seen the heavy double spindle shaper for dressing felloes inside and out.

The boring and tanging machines are not shown in this picture, but in the foreground may be seen felloes for military wheels, with large dowel holes and holes for double-shouldered spoke tangs.

No 4 shows the top of the Tyresetter. This is a machine set in a big circular pit, so that its top is nearly flush with the shop floor. The heaviest wheels may be rolled right on. The machine, with all parts, weighs about fourteen tons. It is one of the largest made (larger have been made for use in the Argentine, where wheels over 10ft are used). Its range includes all wheels up to 6' 9", and tyres of any section up to 8" x 2" or the equivalent. It would not be possible to properly make heavy motor lorry wheels without this machine, because neither iron nor steel expands enough to get the necessary compression to make a compact wheel of the artillery pattern, in which the spoke feet simply nest together. The tyre must supply the compression which is ordinarily obtained by driving the spoke into a mortise.

When the motor car came in, the artillery type of wheel was quickly proven the most serviceable, but pneumatic and solid rubber tyres introduced new problems in tyring, requiring accuracy in workmanship not previously regarded as of first importance.

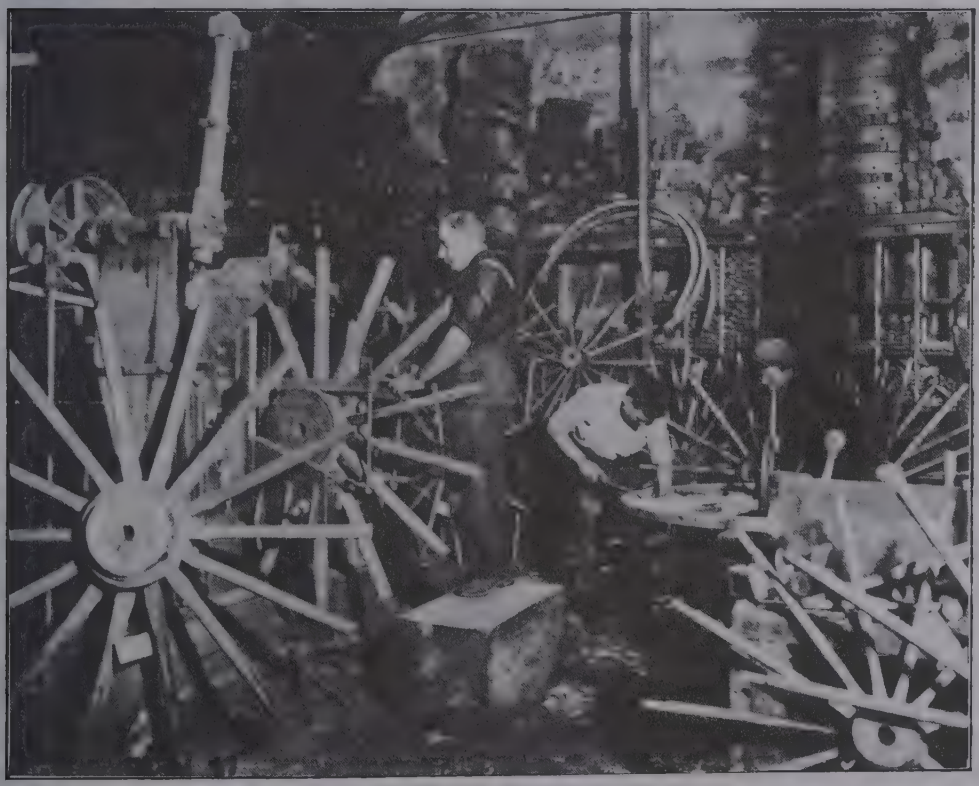
Instead of tyres being made to fit the wheels, motor wheels have to be made to fit the rims which hold the tyres. To meet these requirements we put in a complete plant for all the operations in motor wheel making.

The No 2 tyre setter, in which wheels are compressed ready for tyring, is shown in the foreground.

The lathe for turning felloes, boring out and facing for hub centres, is shown on page 7. Heavy wheels have the steels for solid tyres put on in the No 7 Tyresetter, shown on page 8, while solid rubbers are pressed on or off with the 100 ton hydraulic press shown on page 9.

The power developed by the Tyre Setter is always proportionate to the resistance offered by the tyre. It varies with the size of the tyre. On a section of 16 square inches a pressure equivalent to a dead lift of 1800 tons is developed. It is important to note that it is the tyre which takes the pressure and not the wheel. The pressure on the wheel transmitted through the tyre is simply enough to compress the wood to keep all joints tight and the tyre on.

These pictures show only the special features of our plant. In addition we have automatic spoke lathes, tenoning, throating, facing and polishing machines; also lathe for turning naves and separate machines for boring for mortises and central hole to facilitate seasoning; also planing machines, band and circular saws, etc.



No. 2 – Spoke driving machine.

No. 5 – 100 ton hydraulic boxing press.

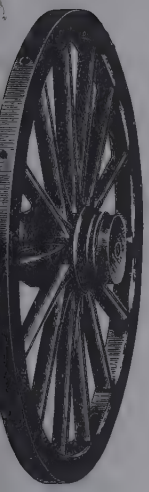
The details on the next two pages are reprinted from the catalogue of Jonas Woodhead of Leeds (approx. 1906), and are included to show the standard range of ready made wheels available to the trade. Both model makers and carriage restorers will find the tables useful in checking the authentic sizes and proportions of carriage and waggon wheels.

Note the features available as optional extras. The coach type wheels could have bent rims, i.e. constructed from two semi-circular steam bent sections, instead of from six or seven separated fellies. Bolts or rivets could be added to secure the tyres to the rims nailing was standard for waggon wheels.

Two further pages from the same catalogue appear on the inside of the cover.

BEST QUALITY ENGLISH MADE WHEELS

COACH PATTERN



WARRANTED
LL MADE FROM
SELECTED
AND
EASONED
TIMBER
AND OF
E BEST QUALITY
AND
WORKMANSHIP

No. of Wheel	Height of Wheels in the Wood	No. of Spokes	Size of Spokes	Length of Naves	Dia. of Naves	Size of Felloes	Width or Tyres	Price per pair in the Wood	Tyring per pair including Nave Hoops
	Ft. In. Ft. in.		In.	In.	In.	In.	In. In.		
4039	2 8 to 2 10	12	1½	7	5¾	1¾	1¼ or 1⅜	£1 10 6	£0 19 0
4040	3 0 ,, 3 2	12	1⅝	7	5¾	1¾	,, ,,	1 13 0	0 19 6
4041	3 4 ,, 3 6	14	1½	7	6	1⅞	,, ,,	1 16 0	1 1 0
4042	3 8 ,, 3 10	14	1½	7	6	1⅞	,, ,,	1 18 0	1 1 6
4043	2 8 ,, 2 10	12	1⅝	7½	6	1⅞	,, ,,	1 12 0	0 19 0
4044	3 0 ,, 3 2	12	1⅝	7½	6	1⅞	,, ,,	1 14 0	0 19 6
4045	3 4 ,, 3 6	14	1⅝	7½	6½	2	,, ,,	1 17 0	1 1 0
4046	3 8 ,, 3 10	14	1⅝	7½	6½	2	,, ,,	1 19 6	1 1 6
4047	4 0 ,, 4 2	14	1⅝	7½	6½	2	,, ,,	2 2 6	1 2 0
4048	2 10 ,, 3 0	12	1¾	8	6½	2⅛	1⅜ ,, 1½	1 14 0	0 19 0
4049	3 2 ,, 3 4	12	1¾	8	6½	2⅛	,, ,,	1 17 0	1 1 0
4050	3 6 ,, 3 8	14	1¾	8	7	2⅛	,, ,,	2 1 6	1 1 6
4051	3 10 ,, 4 0	14	1¾	8	7	2⅛	,, ,,	2 3 6	1 3 6
4052	4 2	14	1¾	8	7	2⅛	,, ,,	2 4 6	1 3 6
4053	4 4 ,, 4 6	14	1¾	8	7	2 3/16	,, ,,	2 6 6	1 5 6
4054	3 0 ,, 3 2	12	1⅞	8½	7	2¼	1½ ,, 1⅝	1 16 0	1 3 6
4055	3 4 ,, 3 6	12	1⅞	8½	7	2¼	,, ,,	1 18 0	1 4 6
4056	3 8 ,, 3 10	14	1⅞	8½	7½	2¼	,, ,,	2 2 6	1 5 6
4057	4 0 ,, 4 2	14	1⅞	8½	7½	2¼	,, ,,	2 5 6	1 7 6
4058	4 4 ,, 4 6	14	1⅞	8½	7½	2¼	,, ,,	2 8 0	1 7 6
4059	3 0 ,, 3 2	12	2	9	7½	2⅜	1⅝ ,, 1¾	1 17 0	1 4 6
4060	3 4 ,, 3 6	12	2	9	7½	2⅜	,, ,,	2 0 6	1 5 6
4061	3 8 ,, 3 10	14	2	9	8	2⅜	,, ,,	2 3 6	1 6 6
4062	4 0 ,, 4 2	14	2	9	8	2⅜	,, ,,	2 6 6	1 8 6
4063	4 4 ,, 4 6	14	2	9	8	2⅜	,, ,,	2 10 0	1 9 0
4064	4 8	14	2	9	8	2⅜	,, ,,	2 11 0	1 9 0
4065	3 2 ,, 3 4	12	2⅛	9⅛	8	2⅜	1¾ ,, 2	2 2 6	1 5 6
4066	3 6 ,, 3 8	12	2⅛	9⅛	8	2⅜	,, ,,	2 8 0	1 7 6
4067	4 0 ,, 4 4	14	2⅛	9½	8½	2⅜	,, ,,	2 11 0	1 12 0
4068	4 6 ,, 4 8	14	2⅛	9½	8½	2⅜	,, ,,	2 13 0	1 12 0
4069	3 2 ,, 3 4	12	2¼	10	8½	2⅝	,, ,,	2 4 6	1 7 6
4070	3 6 ,, 3 8	12	2¼	10	8½	2⅝	,, ,,	2 9 0	1 8 0
4071	4 0 ,, 4 2	14	2¼	10	9	2⅝	,, ,,	2 12 0	1 12 0
4072	4 4 ,, 4 6	14	2¼	10	9	2⅝	,, ,,	2 14 0	1 12 0
4073	4 8	14	2¼	10	9	2⅝	,, ,,	2 15 0	1 12 0
4074	3 2 ,, 3 4	12	2½	11	9½	3	2 ,, 2¼	2 9 0	1 9 6
4075	3 6 ,, 3 8	12	2½	11	9½	3	,, ,,	2 13 0	1 12 0
4076	4 0 ,, 4 4	14	2½	11	10	3	,, ,,	2 16 6	1 16 0
4077	4 6 ,, 4 8	14	2½	11	10	3	,, ,,	2 18 6	1 16 0
4078	3 2 ,, 3 4	12	2⅝	11½	10	3⅛	2¼ ,, 2½	2 11 0	1 14 0
4079	3 6 ,, 3 8	12	2⅝	11½	10	3⅛	,, ,,	2 15 0	1 14 0
4080	4 0 ,, 4 4	14	2⅝	11½	10½	3⅛	,, ,,	2 19 6	1 18 0
4081	4 6 ,, 4 8	14	2¾	11½	10½	3⅛	,, ,,	3 1 6	1 18 6

EXTRAS ON THE ABOVE PRICES

heels for Varnishing 2/- per pair Bent Rims 5/- 6/- 7/- and 8/- per pair according to strength Screwing Rims 2/6 to 3/- per pair
Boring out for Bushes 1/- to 1/6 each Wheel according to size Bushing and Wedging complete 4/- per pair
Prices of Tyring include Nails and Single Rivets and Cleaning off complete
Double Rivets 2/- per pair Bolts 2/- per pair extra on Prices of Tyring Bushes must be sent Carriage Paid
For Prices of Brass, White Metal and Special Nave Hoops see pages 30 and 31

Order by Number and Specify Width of Tyre and Height of Wheel
In the absence of Special Instructions to the contrary Standard Wheels will be sent

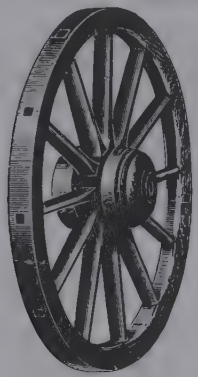
TRUCK OR HAND CART WHEELS

	Plain Hub Pattern as illustrated					Warner Hub Pattern			Tyring including Stock Hoops and Nails				
Size of Spokes ...	1½	1⅝	1¾	1⅞	2	1½	1⅝	1¾ in.		1⅛ × 3/8	1¼ × 5/16	1½ × 3/8	in.
Length of Hubs	6½	7	8	8½	9	6½	7	8 ,,					,,
Height	4158	4162	4166	4170	4174	4178	4182	4186	Up to 3ft. 0in.	5/9	6/3	8/9	per pair
2ft. 2in. to 2ft. 6in.	11/-	12/6	14/6	17/-	19/6	13/-	14/-	16/3					
	4159	4163	6167	4171	4175	4179	4183	4187	,, 3ft. 2in.	6/3	6/9	9/3	,,
2ft. 8in. ,, 3ft. 0in.	11/9	13/-	15/3	17/6	20/3	13/9	15/-	17/3					
	4160	4164	4168	4172	4176	4180	4184	4188	,, 3ft. 4in.	6/9	7/3	9/9	,,
3ft. 2in. ,, 3ft. 6in.	12/6	13/9	16/-	18/3	21/-	14/6	16/-	18/-					
	4161	4165	4169	4173	4177	4181	4185	4189	,, 3ft. 6in.	7/-	8/-	10/3	,,
3ft. 8in. ,, 4ft. 0in.	13/9	15/-	17/-	19/6	22/-	15/9	17/-	19/3	,, 4ft. 0in.	8/-	9/-	11/6	,,

Quotations for AMBULANCE MOTOR CAR and other SPECIAL WHEELS against Specification

HEAVY CART VAN AND WAGON WHEELS

SPOKES
LET IN FULL SIZE
AND
ROUND TANGS

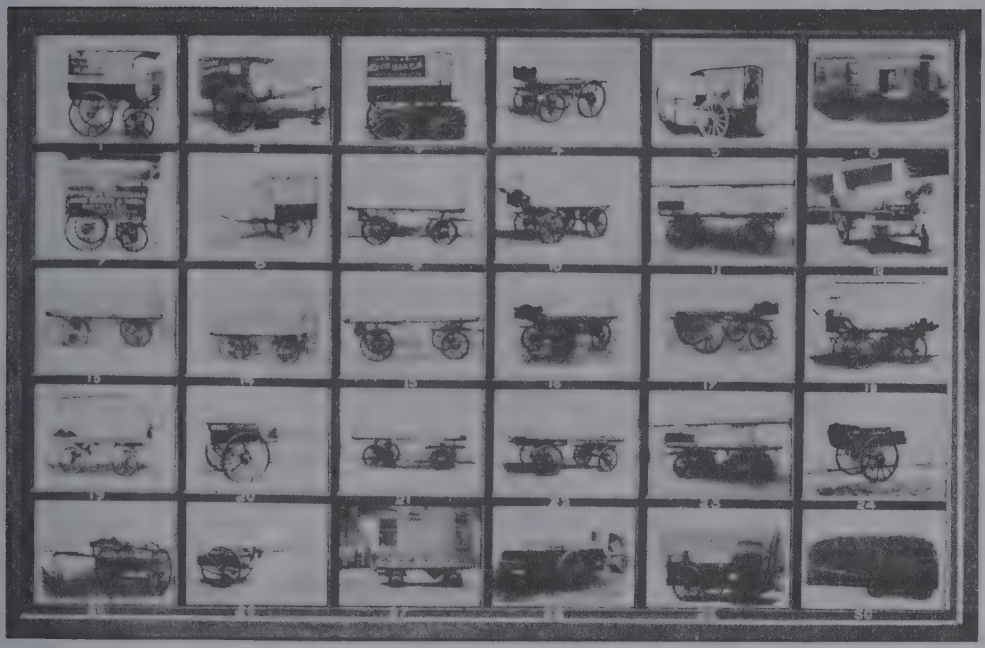


BEST QUALITY
MADE FROM
SEASONED TIMBER

No. of Wheel	Height of Wheels in the Wood	Size of Spokes	Approximate Size of Naves	Size of Felloes	Width of Tyres	Price per pair in the Wood with Naves H'ped	Tyring per pair extra ⅝ in. thick	Tyring per pair extra ¾ in. thick	Tyring per pair extra ⅞ in. thick
4082	4 ft. 4 in. to 4 ft. 6 in.	3¼ × 1⅜ in.	11½ × 10¼ in.	3¼ in.	2½ in.	£3 13 0	£1 6 6	£1 8 6	...
4083	4 „ 8 „ 4 „10 „	„	„	3⅜ „	2¾ „	3 16 0	1 7 6	1 9 6	...
4084	4 „ 4 „ 4 „ 6 „	„	„	3⅜ „	2½ „	3 13 0	1 8 6	1 10 0	...
4085	4 „ 8 „ 4 „10 „	„	„	3½ „	2⅝ „	3 16 0	1 9 6	1 10 6	...
4086	4 „ 4 „ 4 „ 6 „	„	„	3⅝ „	2¾ „	3 13 0	1 10 0	1 11 0	...
4087	4 „ 8 „ 4 „10 „	„	„	3⅝ „	2¾ „	3 16 0	1 11 0	1 12 0	...
4088	4 „ 4 „ 4 „ 6 „	„	„	3¼ × 3 in.	3 „	3 13 0	1 12 0	1 14 0	...
4089	4 „ 8 „ 4 „10 „	„	„	3¼ × 3 „	3 „	3 16 0	1 13 0	1 15 0	...
4090	4 „ 4 „ 4 „ 6 „	„	„	3¾ × 3 „	3½ „	3 16 0	1 17 0	2 0 0	...
4091	4 „ 8 „ 4 „10 „	„	„	3¾ × 3 „	3½ „	3 18 6	2 0 0	2 2 6	...
4092	4 „ 4 „ 4 „ 6 „	„	„	4¼ × 3 „	4 „	3 19 0	2 2 6	2 5 0	...
4093	4 „ 8 „ 4 „10 „	„	„	4¼ × 3 „	4 „	4 1 6	2 5 0	2 8 0	...
4094	4 „ 4 „ 4 „ 6 „	3½ × 1½ in.	12½ × 11½ in.	3⅜ in.	2½ „	3 16 0	...	1 8 6	...
4095	4 „ 8 „ 4 „10 „	„	„	3⅜ „	2½ „	3 18 6	...	1 9 6	...
4096	4 „ 4 „ 4 „ 6 „	„	„	3¾ „	2¾ „	3 16 0	...	1 11 0	...
4097	4 „ 8 „ 4 „10 „	„	„	3¾ „	2¾ „	3 18 6	...	1 12 0	...
4098	4 „ 4 „ 4 „ 6 „	„	„	3⅝ „	3 „	3 16 0	...	1 14 0	...
4099	4 „ 8 „ 4 „10 „	„	„	3⅝ „	3 „	3 18 6	...	1 15 0	...
4100	4 „ 4 „ 4 „ 6 „	„	„	3¾ × 3⅛ in.	3½ „	3 19 0	...	2 0 0	...
4101	4 „ 8 „ 4 „10 „	„	„	3¾ × 3⅛ „	3½ „	4 1 6	...	2 2 6	...
4102	4 „ 4 „ 4 „ 6 „	„	„	4¼ × 3⅛ „	4 „	4 1 6	...	2 5 0	...
4103	4 „ 8 „ 4 „10 „	„	„	4¼ × 3⅛ „	4 „	4 4 6	...	2 8 0	...
4104	4 „ 4 „ 4 „ 6 „	„	„	4¾ × 3⅛ „	4½ „	4 7 0	...	2 10 6	...
4105	4 „ 8 „ 4 „10 „	„	„	4¾ × 3⅛ „	4½ „	4 10 0	...	2 13 0	...
4106	4 „ 4 „ 4 „ 6 „	3½ × 1⅝ in.	12½ × 12 in.	3½ in.	2½ „	3 18 6	...	1 11 0	£1 13 0
4107	4 „ 8 „ 4 „10 „	„	„	3⅜ „	2½ „	4 1 6	...	1 12 0	1 14 6
4108	4 „ 4 „ 4 „ 6 „	„	„	3½ „	3 „	3 18 6	...	1 14 0	1 17 6
4109	4 „ 8 „ 4 „10 „	„	„	3½ „	3 „	4 1 6	...	1 15 0	2 0 0
4110	4 „ 4 „ 4 „ 6 „	„	„	3¾ × 3½ in.	3½ „	4 1 6	...	2 0 0	2 5 0
4111	4 „ 8 „ 4 „10 „	„	„	3¾ × 3½ „	3½ „	4 4 6	...	2 2 6	2 8 0
4112	4 „ 4 „ 4 „ 6 „	„	„	4¼ × 3½ „	4 „	4 4 6	...	2 5 0	2 10 6
4113	4 „ 8 „ 4 „10 „	„	„	4¼ × 3½ „	4 „	4 7 0	...	2 8 0	2 13 0
4114	4 „ 4 „ 4 „ 6 „	„	„	4¾ × 3½ „	4½ „	4 10 0	...	2 10 6	2 16 0
4115	4 „ 8 „ 4 „10 „	„	„	4¾ × 3½ „	4½ „	4 12 6	...	2 13 0	2 18 6
4116	4 „ 4 „ 4 „ 6 „	3⅝ × 1⅝ in.	13½ × 12¼ in.	3⅝ in.	2½ „	4 1 6	...	1 11 0	1 13 0
4117	4 „ 8 „ 4 „10 „	„	„	3⅝ „	2½ „	4 4 6	...	1 12 0	1 14 6
4118	4 „ 4 „ 4 „ 6 „	„	„	3½ „	3 „	4 1 6	...	1 14 0	1 17 6
4119	4 „ 8 „ 4 „10 „	„	„	3⅝ „	3 „	4 4 6	...	1 15 0	2 0 0
4120	4 „ 4 „ 4 „ 6 „	„	„	3¾ × 3½ in.	3½ „	4 7 0	...	2 0 0	2 5 0
4121	4 „ 8 „ 4 „10 „	„	„	3¾ × 3½ „	3½ „	4 10 0	...	2 2 6	2 8 0
4122	4 „ 4 „ 4 „ 6 „	„	„	4¼ × 3½ „	4 „	4 10 0	...	2 5 0	2 10 6
4123	4 „ 8 „ 4 „10 „	„	„	4¼ × 3½ „	4 „	4 12 6	...	2 8 0	2 13 0
4124	4 „ 4 „ 4 „ 6 „	„	„	4¾ × 3½ „	4½ „	4 13 0	...	2 10 6	2 16 0
4125	4 „ 8 „ 4 „10 „	„	„	4¾ × 3½ „	4½ „	4 15 6	...	2 13 0	2 18 6

If with Square Tangs 3/6 per pair extra
These Prices are for Wheels with 12 Spokes Wheels with 14 Spokes 5/- to 7/6 per pair extra
Price includes Square Edge Nave Hoops
Wheels (12 Spokes) with Tenoned Spokes and Round Tangs 2/6 per pair less than list
„ (14 Spokes) „ „ „ same price as list
Oak Naves 3/- per pair extra
Prices of Tyring include Nailing and Dressing off Bolts or Rivets extra
Boring out for Bushes 2/6 per pair Bushing and Wedging complete 4/6 per pair extra
Bushes must be sent Carriage Paid

Usual Dish about ½ in. on Spokes If more or less than this required state when ordering



A VEHICLE BUILDER – "HENRY EATON OF MANCHESTER"

As well as illustrating a selection of trade and goods vehicles the 'Henry Eaton' catalogue is unusual in that it presents those informative general views of the works. It can be seen that there is plenty of space to handle the completed vehicles, and that quite large batches of identical vehicles were sometimes built. However this could give a wrong impression of the general type of work no doubt the photographs were taken when large orders were in evidence and I suspect that, normally, the output was more of a mixed bag.

HENRY EATON, Wheelwright,

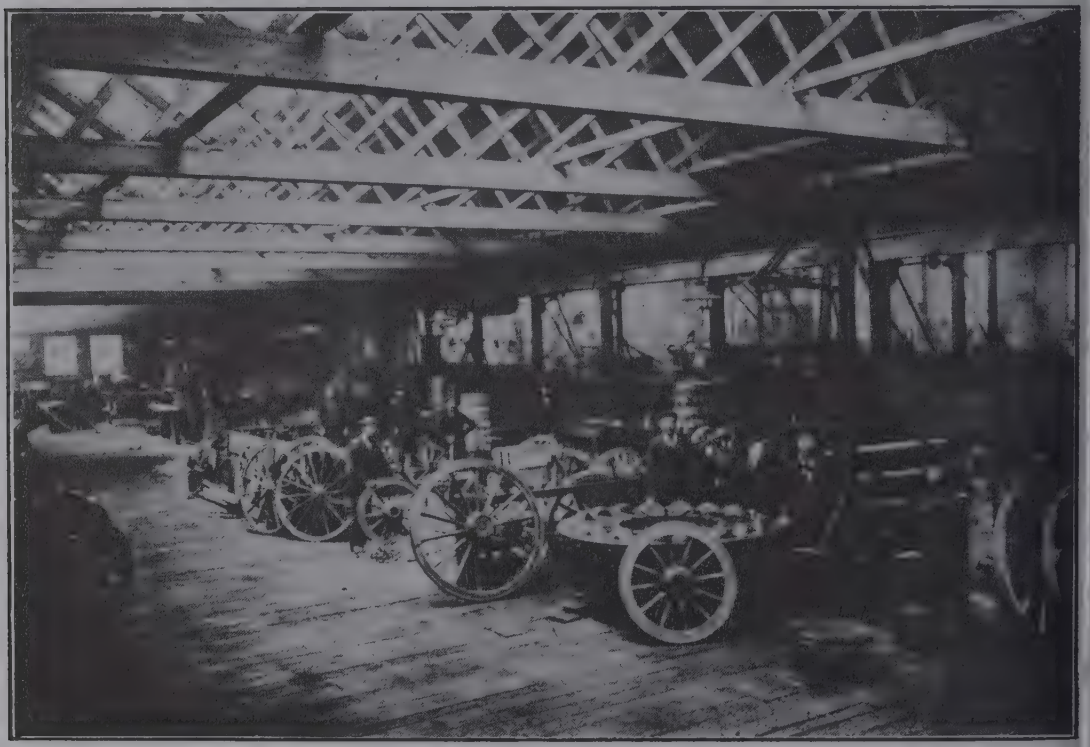
107 Palmerston Street, Manchester, S.E.

Part of the Staff, 1904.

▲ *A batch of vans for "Tramways Parcel Express".*

▼ *The finishing shop.*

▲*General view of assembly shop.*



▼*The tyring department, with hydraulic tyre setter.*

The wood machining shop – note belt drives from lay shaft.

The blacksmiths' shop – note forges against the wall on the right.

CROSSKILLS OF BEVERLEY

(From the 1904 catalogue of "The East Yorkshire & Crosskills Cart and Waggon Co. Ltd. of Beverley".)

William Crosskill set up in business in 1827, and quickly expanded to become a leading exporter to the colonies and the U.S.A. He was a pioneer in the use of cast iron hubs and patent axles. The output of the firm was mostly trade and agricultural vehicles but wheels and components were also supplied.

General Specification of Vehicles.

Body Framework. Is of best quality Oak or Ash, naturally seasoned, and free from loose knots, sap and other defects.

Panels. Are of best quality Baltic timber, Pitch Pine, Birch, Elm, &c.

Shafts. Of English Ash.

Underframing. Of English Ash or Oak.

Wheels. Spokes of cleft Oak.
Felloes, English Ash.
Naves, Oak or Elm.
Unless otherwise stated.

Ironwork. Best Staffordshire or equal.

Cast Iron. Of good hard quality.

Tyres. Wrought Iron or Mild Steel.

Springs. Best manufacture of Sheffield Steel Plates.

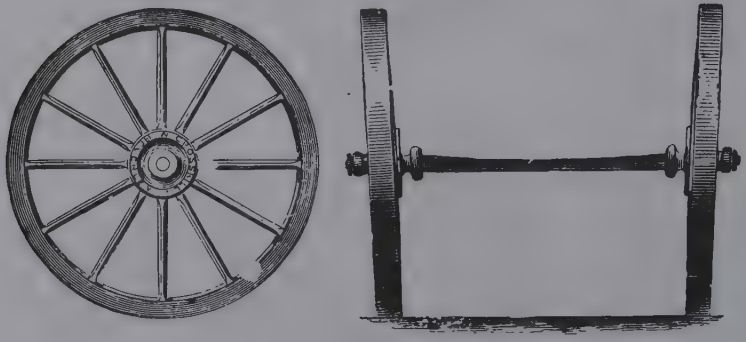
Axles. Best fagotted re-manufactured Scrap, all turned accurately, fitted and made interchangeable to our standard gauge.

Painting. Ordinary Vehicles best oil color, lined and picked out.

Lamps to all vehicles extra.
India Rubber Tires extra.

TRADE VANS AND LIGHT VEHICLES RECEIVE SPECIAL ATTENTION AND FINISH.

WOOD WHEELS with Cast Iron Naves, as illustrated, or Wood Naves.



The above Wheels are made in various strengths and sizes to carry 5-cwts. and upwards.
Diameter 2.ft. 6-in. and upwards and Tires 1½-in. to 8-in. wide.
For prices see list.

CART and WAGGON AXLES.

Made of best re-manufactured Scrap Iron. Arms turned and case-hardened. Solid Beds, and welded to any ordinary length.
No extra charge for shutting up.

Axles for Steel or Wrought Iron Wheels or Wood Wheels with Iron Naves.

Size - 1¼-in. 1½-in. 1¾-in. 2-in. 2¼-in. 2½-in. 2¾-in. 3-in. 3¼-in. 3½-in. All prices as per list.

Axles with Hard Metal Chilled Bushes, for Wood Nave Wheels.

Size - 1¼ in. 1½-in. 1¾-in. 2-in. 2¼-in. 2½-in. 2¾-in. 3-in. 3¼-in. 3½-in. All prices as per list.

Drabble's Patent Axles with Chilled Bushes and Brass Oil Caps and Spanner.

Size - 1½-in. 1¾-in. 2-in. 2¼-in. 2½-in. 3-in. 3¼-in- 3½-in. All prices as per list.

Mail Patent Axles with long Bolts, Chilled Bushes, and Brass Oil Caps and Spanner.

Size - 1-in. 1⅛-in. 1¼-in. 1⅜-in. 1½-in. 1⅝-in. 1¾-in. 1⅞-in. 2-in. All prices as per list.

SPECIAL QUOTATIONS FOR QUANTITIES.

Axles or Arms fitted with Iron Naves or Hubs.

Arms or Axles made of best re-manufactured Scrap Iron, turned and case hardened.
Naves or Hubs of hard Cast Iron, bearing chilled.

1⅛-in. Arms and	Pair of	Iron	Naves or Hubs.	2-in. Arms and	Pair of	Iron	Naves or Hubs.
1¼-in.	do.	do.	do.	2¼-in.	do.	do.	do
1⅜-in.	do.	do.	do.	2⅜-in.	do.	do.	do.
1½-in.	do.	do.	do.	2½-in.	do.	do.	do.
1⅝-in.	do.	do.	do.	3-in.	do.	do.	do.

Prices as per list.

If fitted with Oil Boxes, 1⅛-in. Axles to 1½-in. price per pair extra as list.
Do. do. 1¾-in. do. 2¼-in. do do.
Do. do. 2½-in. do. 3-in. do. do.

SPECIAL QUOTATIONS FOR QUANTITIES.

GENERAL SPECIFICATION OF MATERIALS see page 3.

An illustration of the French "Marechal Grossier" from "L'Encyclopedia" of Denis Diderot, published in 1762.

FOREIGN WHEELMAKING METHODS

This article appeared in 'The Blacksmith's magazine' in 1901. I cannot vouch for the accuracy of the generalisations concerning French and German Wheelwrights – after all in Great Britain practices varied greatly from region to region, especially between town and country, so it is dangerous to draw conclusions from any limited sample.

The construction of wheels is a matter of first importance, for upon that more than anything else does the success of a vehicle depend. The carriage-builders of the United States have recognised this fact, and have given the matter such thorough attention that it may be said of the wheels now in use that they are approximately perfect. This will be all the more obvious if we compare them with those made in other countries, and especially with those built in France. French wagon wheels have always been inferior both in the quality of the material used and in the workmanship. The hubs are usually made of elm, and the spokes and rims of acacia, oak or ash. Elm answers very well for hubs, provided the best quality be selected; but the French have used large amounts of inferior wood, reserving their best stock for pleasure carriages and fine delivery wagons built to order. The wood of the acacia tree is, at its base, hard and stiff and suitable for spokes; but if taken from any part of the tree more than three feet above the ground it is unfit for such use, although a great deal of it has been so used and is yet being used. Oak answers very well for spokes, but it is not plentiful. French ash is equal to any growth elsewhere. It is hard, close-grained and well adapted for the carriage-builders' use, but it is scarce and costly, and much of that now used is of an inferior quality.

The workmanship of French wheels has never been worthy of imitation and shows very little signs of improvement. It is true that some concerns in that country make a specialty of producing hubs, spokes, and rims, but they have not had sufficient experience at it to do work which compares favourably with that produced in the United States. Besides, it should be noted that the builders of that country prefer to turn and mortise their own hubs, cut out their own spokes and saw out their own felloes, and this practice is not likely to be discontinued until they can procure the same goods at a less price than it now costs to manufacture them by hand work. There are mortising machines in France, of course, but they are in every sense inferior, and it is impossible to turn out the same amount of work with them as can be done on American machines, or to do it equally well.

In this country spokes are almost wholly made by machinery. Such spokes are better than those made by hand, because they are exactly alike in all particulars, and the square tenons are compressed by machinery before they are driven. French spokes, on the contrary, are badly shaped and badly throated, and no two of them are alike. In wheel-building the French workman has adopted a practice unknown elsewhere, and one worse than which it is impossible to imagine. The wheeler in driving spokes has the hub endwise on the floor. The wheeler's back being bent, he chases the wheel about the floor after each blow. The driving hammer is heavy and drives the spokes tight, as all hubs are banded when driven. If a spoke has to be forced backward or forward the wheeler's feet are used to hold the wheel while he pulls the spokes with a stick.

The wheel-makers of England and Germany use what is called a wheel-pit, a device which enables them to do their work in less time. One noticeable error on the part of the French workman is found in his method of fitting his spokes to the hubs. The shoulders of the spokes are not cut to fit the dish of the wheel. He must, therefore, cut out the hub to allow the spokes to fit. This cutting may be 1-8-inch for each spoke, but it means taking away timber from the hub where it is most needed, besides the great injury of breaking the grain of the timber itself.

Both in France and Germany wheels are hubbed, and the rims and felloes finished afterward. American workmen, on the other hand, invariably finish the rims and felloes first. The advantages of this method are obvious, for both the inner and outer surfaces of the felloes can be finished in one-half the time and far better than would be possible if the tires were on. As before explained, hubs are turned out and mortised by machinery. They are made of the best material, are perfect in shape and are invariably alike. This holds true with the spokes generally, although it sometimes happens that the flat tenons do not fit the mortises of the hub, as the bevel on the rear end is not right. In such case the American mechanic employs a little machine on which the spoke is shaved down to the right dimension, while at the same time the bevel of the shoulder is properly prepared. On a light-built American wheel of fourteen spokes, two different shoulders are produced, those for the front spokes being nearly square, while those for the rear receive more bevel since they are dished. All such differences, however, are regulated by the position of the spokes in the machine. The bevel for the rear surfaces is treated in the same way as for the front.

Spoke-driving in the case of light, medium and heavy wheels, is done by resting the hub in a horizontal position on what the English call the wheel wheel-pit; for most work this is better than the heavy trestle. In American wheels most spokes are glued when driven a practice which has produced satisfactory results. The American practice of rimming wheels, as now carried on, is the best possible from a mechanical point of view. The wheel lays in a horizontal position, and the cutting of the spoke tenon is an easy matter since the tenons are of the same length and size at the shoulder. It is far less expensive than the French method, and the wonder is that it should not long ago have been adopted in all civilized countries. With the same tool, also, it is possible to bore the holes in the rims and felloes with perfect accuracy. It should be noted, too, that the American wheels have their tyres set by what is called the cold-shrinkage system, the effect of which is to keep them in good shape.

COOKE'S OF LINCOLN

Cooke's Wheelwright business catered for a farming area and was well known for its production of ploughs and agricultural implements. The carts and waggons retained some local characteristics – in particular the 'Hermaphrodite' (p. 69) was typical of the Eastern counties but did not gain favour elsewhere.

Cranked Axle Spring Floats.

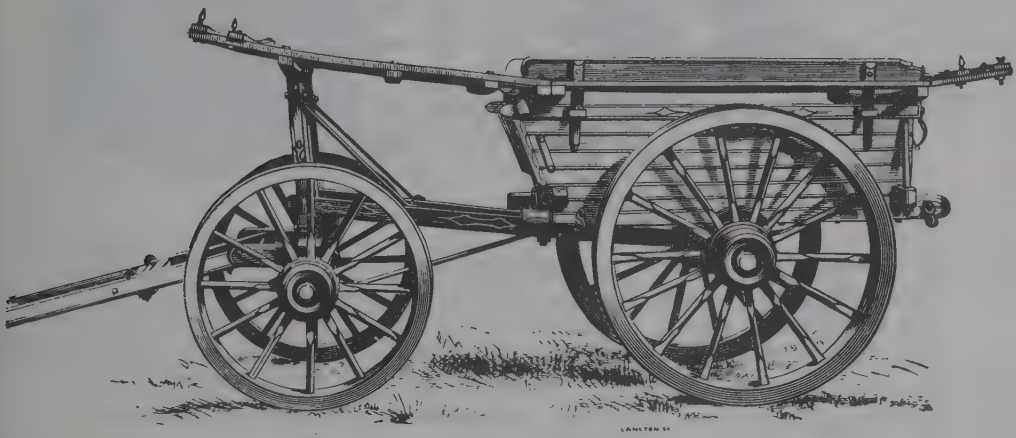
The above are made in several sizes as below, and are suitable for carrying Pigs, Sheep, etc. They are mounted on best steel springs and mail patent arms with brass oil caps, and are very easy running.

No. 1—Body, 6 ft. 6 in. by 3 ft. 10 in. outside; 3 ft. 6 in. deep, over all; slotted sides; hind door 6 in. higher than sides; straight ash shafts with footboard and step; wheels, 4 ft. 6 in. diameter, 14 spokes; tyres, 2 in. by $\frac{3}{4}$ in.; $1\frac{3}{4}$ in. mail patent 18 in. cranked axle; to carry 15 cwts.; weight, $9\frac{1}{4}$ cwts.

No. 2—Body 5 ft. 9 in. by 3 ft 6 in. outside; 3 ft. deep, over all; plank sides; wheels, 4 ft. diameter, 14 spokes; tyres 2 in. by $\frac{5}{8}$ in.; $1\frac{1}{2}$ in. mail patent 12 in. cranked axle; to carry 10 cwts.; weight $6\frac{3}{4}$ cwts.

COOKE'S
NEWLY-IMPROVED
Combined Cart and Wagon.

A perfect Cart, and as useful as a Wagon, for harvesting, &c., &c.



The above consists of a front carriage and wheels, etc., with shelvings and other fittings attached to an **ordinary General-Purpose Two-horse Farm Cart,** in such manner that they can be easily detached or put together again as required in a few minutes, by any carter or farm labourer, etc.

It is as useful as a Wagon for harvesting and other purposes, and is especially suited by its adaptability to uneven surfaces, and cheapness, for hilly districts and small occupations, etc.

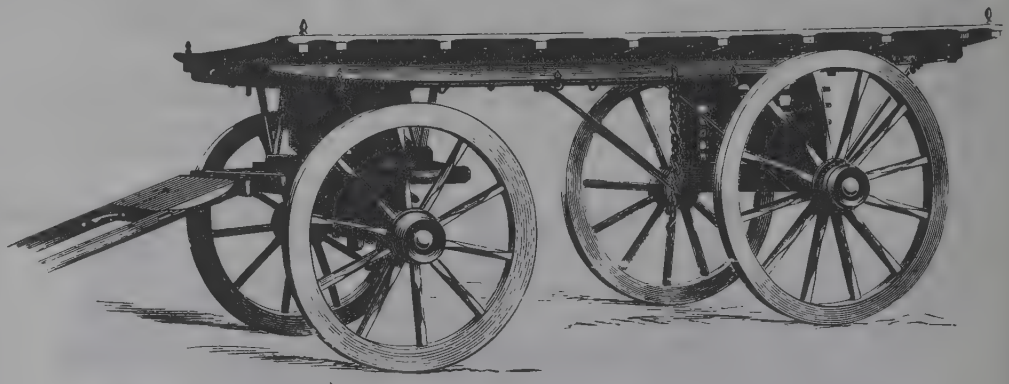
It is remarkably handy, can be turned in its own length, and effectually answers the purposes of both a Wagon and a Cart.

It is fitted with 4 in. wheels and patent arms to cart and turned iron grease arms to front wheels.

Extras. - - Slipper and Lock Chain.

COOKE'S

Farm or Hay Drays or Lurries.



These Drays are suitable for hay and straw dealers, etc., and for general farm use. They may be fitted with end rails or gormers for conveniently loading up and carrying large loads of hay or corn, etc., in harvest time. They may also be fitted with loose side and end boards or rails, for carrying potatoes, turnips, etc., also coal, coke, bones, etc. Fitted with patent arms and brass oil-caps, and box under the body behind for ropes, tools, etc., also slipper and lock chain complete. Slipper and lock chain are not supplied when Brake is fitted.

To carry up to 2 tons. Body, 11 ft. by 5 ft. 9 in.; wheels, 4 ft. and 3 ft. 6 in. diameter; 3 in. tyres.

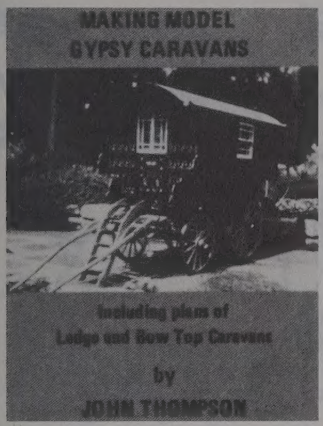
To carry up to 2½ tons. Body 11 ft. 6 in. by 6 ft.; wheels, 4 ft. and 3 ft. 6 in. diameter; 3½ in. tyres.

To carry up to 3 tons. Body, 11 ft. 6 in. by 6 ft.; wheels, 4 ft. and 3 ft. 6 in. diameter; 4 in. tyres.

Extras.

Double shafts, arranged to work single if required. Single Wood Beam Screw Brake. Improved Screw Brake, Harvest Ladders (front and back). Loose Side and End Boards, all round. Loose Side and End Boards and Sheep Rails combined.

BOOKS by John Thompson



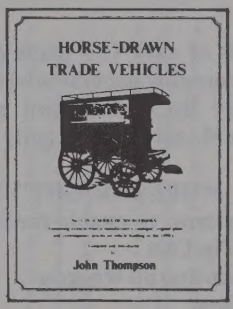
"MAKING MODEL GYPSY CARAVANS"

The Gypsy Caravan is probably the most popular horse-drawn vehicle as a subject for modelmakers, and no wonder for it gives scope not only for woodwork and metalwork, but for carving, colourful painting, and the making of internal fittings. This large format book is very fully illustrated with photographs and plans, and deals with all the aspects from choice of materials to finishing the model.

There are detailed notes on the construction of the ornate Ledge waggon and a little Open Lot Bow Top, whilst the beginner is catered for by a simple plan for a Showman's caravan. Bound in a card jacket with full colour photograph.

In the same series:–

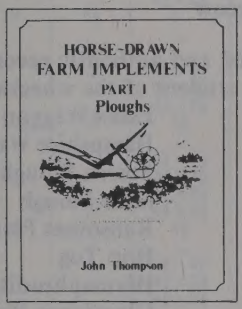
"MAKING MODEL HORSE DRAWN VEHICLES"
"MAKING MODEL CARRIAGES"



THE "HORSE-DRAWN" SERIES OF SOURCE BOOKS

The books in this unique series all comprise fascinating extracts from makers' catalogues, trade journals and out-of-print books from the 19th Century, when horse-drawn transport was dominant on the roads and farms. All these volumes are fully illustrated, from the original clear engravings, and provide a wealth of detailed information for the enthusiast and the modelmaker.

Available from bookshops, or direct from the author.

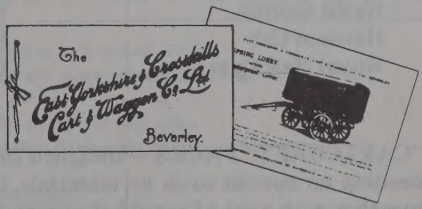


Horse Drawn Trade Vehicles
Horse Drawn Goods Vehicles
Horse Drawn Farm Implements
- **– Part I Ploughs**
- **– Part II Preparing the Soil**
- **– Part III Sowing and Haymaking**
- **– Part IV Harvesting**

Horse Drawn Carriages
Horse Drawn Farm Vehicles
Horse Drawn Carriage Construction

"THE EAST YORKSHIRE & CROSSKILLS CART & WAGGON CO. LTD." 1904 CATALOGUE

The facsimile edition of this very rare and informative catalogue has some 150 full page engravings of trade, farm and private vehicles. It is reproduced and bound in as near to the original style as possible. A fascinating book to browse through and a source for many new ideas for the modelmaker.



All titles available by mail order only from
JOHN THOMPSON, 1 FIELDWAY, FLEET, HAMPSHIRE, GU13 8ER

PLANS by John Thompson

Full details of over 150 plans are given in "The Carriage and Waggon Handbook". This publication also contains general advice on starting the hobby and on books, kits etc. For further details and a price list please send a stamped addressed envelope (International reply coupon from abroad) to Model Wheelwright, 1 Fieldway, Fleet, Hampshire, GU13 8ER.

"MODEL WHEELWRIGHT" PLANS – fully detailed scale drawings, with instructions and cutting patterns, to enable the craftsman of average ability to construct fine models.

Farm Tip Cart	"Courage" Brewers Dray
Monmouthshire Waggon	Bow Top Caravan
Milk Float	Wheelbarrow

THE "FIELDWAY" COLLECTION – Accurate highly detailed and authentic records of a wide range of vehicles from museums, for the serious modelmaker or student of the wheelwright's craft.

Barge Waggon	Wiltshire Dung Cart	Essex Waggon
Medium Timber Bob	Ledge Gypsy Caravan	Hampshire Waggon
Large Timber Bob	Turnwrest Plough	Sussex Plough
Straked Timber Bob	Welsh Long Cart	Mole Plough
Harvest Cart	Oxfordshire Waggon	Ransomes Plough
East Anglian Waggon	Governess Cart	Hop Tug
Timber Carriage	Surrey Dung Cart	Hermaphrodite
Welsh Gambo	Welsh Truckle Cart	Glamorgan Waggon
Hansom Cab	Forest of Dean Waggon	Conestoga Waggon
Royal Mail Coach	Devon Harvest Trolley	Northumberland Cart

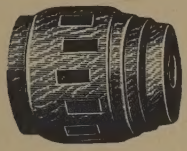
..... plus others in course of preparation

"CARTCRAFT" PACKS – designed for those who want easy to make and attractive models, needing no special tools or materials. Comprise clear plans, full instructions and cutting patterns, together with a set of moulded composition wood finish wheels.

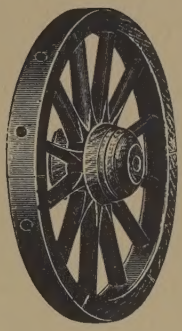
Lake District Cart	Cornish Haywain	Coal Cart
Brewers Dray	Railway Trolley	

LURRY OR DRAY WHEELS IN SETS OF FOUR

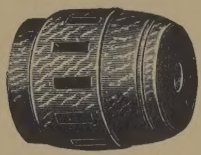
ORDINARY COACH SHAPE



FOR MAIL AXLES



ORDINARY BULL NOSED SHAPE



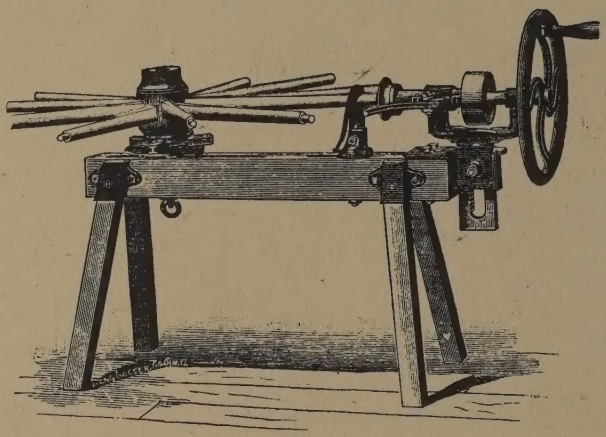
FOR DRABBLES OR CART ARMS

No. of Wheel	Length and Diameter of Naves	Width of Spokes	Size of Felloes	Width of Tyre	Thickness of Tyre	HEIGHT OF WHEELS: 2 ft. 8 in. and 3 ft. 0 in. 2 „ 10 „ „ 3 „ 2 „ — Price per Set in the Wood	2 ft. 8 in. and 3 ft. 0 in. — Price per Set Tyred	3 ft. 0 in. and 3 ft. 4 in. 3 „ 0 „ „ 3 „ 6 „ — Price per Set in the Wood	3 ft. 0 in. and 3 ft. 4 in. — Price per Set Tyred	Thin Edged Frets Extra per Set	Square Edged Frets Extra per Set
	In.	In.	In.	In.	In.	£ s d	£ s d	£ s d	£ s d	s d	s d
4126	7½×6	1⅝	1⅞	1½	⅝	2 18 6	4 7 6	3 1 0	4 13 0	8 6	7 6
4127	8 ×7	1¾	2⅛	1½	,,	3 1 0	4 13 0	3 4 0	4 15 6	8 6	7 6
4128	8½×7½	1⅞	2¼	1⅝	,,	3 4 0	4 18 6	3 6 6	5 3 6	8 6	7 6
4129	9½×8	2	2½	1¾	⅝ or ¾	3 9 0	5 6 6	3 12 0	5 11 6	9 6	8 0
4130	,,	,,	,,	2	,,	3 9 0	5 9 0	3 12 0	5 14 6	9 6	8 0
4131	9½×8½	2⅛	2⅝	1¾	¾	3 12 0	5 9 0	3 14 6	5 14 6	9 6	8 0
4132	,,	,,	,,	2	,,	3 12 0	5 11 6	3 14 6	5 17 0	9 6	8 0
4133	,,	,,	,,	2¼	,,	3 12 0	5 14 6	3 14 6	5 19 6	9 6	8 0
4134	,,	,,	,,	2½	,,	3 12 0	5 19 6	3 14 6	6 5 0	9 6	8 0
4135	10½×9	2¼	2¾	2	,,	3 17 0	5 17 0	4 0 0	6 2 6	10 6	8 0
4136	,,	,,	,,	2¼	,,	3 17 0	5 19 6	4 0 0	6 5 0	10 6	8 0
4137	,,	,,	,,	2½	,,	3 17 0	6 5 0	4 0 0	6 10 0	10 6	8 0
4138	,,	,,	3½×2¾	3	,,	4 2 6	6 15 6	4 5 0	7 1 0	10 6	8 0
4139	,,	,,	3¾×2¾	3½	,,	4 5 0	7 1 0	4 7 6	7 6 0	10 6	8 0
4140	,,	,,	4¼×2¾	4	,,	4 7 6	7 14 0	4 10 6	7 19 6	10 6	8 0
4141	11½×10	2½	3	2¼	,,	4 5 0	6 7 6	4 7 6	6 13 0	11 6	8 6
4142	,,	,,	,,	2½	,,	4 5 0	6 12 6	4 7 6	6 18 0	11 6	8 6
4143	,,	,,	,,	2¾	,,	4 5 0	6 15 6	4 7 6	7 1 0	11 6	8 6
4144	,,	,,	3½×2⅞	3	,,	4 10 6	7 3 6	4 13 0	7 9 0	11 6	8 6
4145	,,	,,	3¾×2⅞	3½	,,	4 13 0	7 8 6	4 15 6	7 14 0	11 6	8 6
4146	,,	,,	4¼×2⅞	4	,,	4 15 6	8 2 0	4 18 6	8 7 6	11 6	8 6
4147	12½×10½	2¾	3½	2¼	,,	4 13 0	7 3 6	4 15 6	7 9 0	12 9	9 6
4148	,,	,,	,,	2½	,,	4 13 0	7 6 0	4 15 6	7 11 6	12 9	9 6
4149	,,	,,	3½×3⅛	3	,,	4 15 6	7 9 0	4 18 6	7 14 0	12 9	9 6
4150	,,	,,	3¾×3⅛	3½	,,	4 18 6	7 14 0	5 1 0	7 19 6	12 9	9 6
4151	,,	,,	4¼×3⅛	4	,,	5 1 0	8 7 6	5 3 6	8 12 6	12 9	9 6
4152	,,	,,	4¾×3⅛	4½	,,	5 6 6	9 6 0	5 9 0	9 11 6	12 9	9 6
4153	13½×11	3	3⅜	2¾	¾ or ⅞	5 1 0	7 14 0	5 3 6	7 19 6	13 3	10 6
4154	,,	,,	,,	3	,,	5 1 0	7 17 0	5 3 6	8 2 0	13 3	10 6
4155	,,	,,	3¾×3⅜	3½	,,	5 6 6	8 5 0	5 9 0	8 10 0	13 3	10 6
4156	,,	,,	4¼×3⅜	4	,,	5 11 6	9 1 0	5 14 6	9 6 0	13 3	10 6
4157	,,	,,	4¾×3⅜	4½	,,	5 17 0	9 19 0	5 19 6	10 4 6	13 3	10 6

These Prices are for 12 and 12 Tenoned Spokes and Round Tangs
Spokes let in full size and Square Tangs **10/-** per set extra according to size
„ „ Round „ **5/-** „ „
Breast Hoops **9d** each Oak Naves **3/-** to **5/-** per set extra
Bushing and Wedging **7/-** to **8/-** per set Boring out for Bushes **4/-** to **5/-** per set extra

Naves turned to any shape required
When ordering state length and shape of Naves and if for Mail Axles or Drabbles Arms
otherwise Standard Pattern Wheels will be sent as illustrated

From Jonas Woodhead of Leeds Catalogue, 1906.



THE WHEELWRIGHT'S TRADE

ISBN 0 906922 09 7

No. 10 in a series of sourcebooks compiled and published

by

JOHN THOMPSON

1 Fieldway, Fleet, Hampshire, U.K.

YO-CHC-040